DOCUMENT RESUME

ED 316 689 CE 054 332

TITLE	Exploratory Study of the Role and Activities of "Centres of Excellence" in the Textile Industry in Four EEC Member States.
INSTITUTION	European Centre for the Development of Vocational Training, Berlin (West Germany).
REPORT NO	ISBN-92-825-8936-6
PUB DATE	88
NOTE	151p.
AVAILABLE FROM	UNIPUB, 4661-F Assembly Drive, Lanham, MD 20706-4391 (Catalogue No. HX-53-88-366-EN-C, $6.00).
PUB TYPE	Reports - Research/Technical (143)
EDRS PRICE	MF01/PC07 Plus Postage.
DESCRIPTORS	Case Studies; Clothing; *Demonstration Programs; Economic Change; Economic Research; *Education Work Relationship; *Fashion Industry; Foreign Countries; Standards; *Technology Transfer; *Vocational Training Centers
IDENTIFIERS	Belgium; *European Community; France; Italy; *Textile Industry; United Kingdom; West Germany

ABSTRACT

The nine centers of excellence described in this document are institutions and geographic areas in the European Economic Community (EEC) that, in addition to providing training and maintaining their links with the labor market, carry out research and disseminate technology with individual firms, groups of firms, and the textile industry as a whole. The centers are located in France, the United Kingdom, Italy, West Germany, and Belgium. The study of these centers was based on questionnaire responses and interviews with the administrative and economic experts at each institution and an analysis of the services offered at each. Chapters 1 and 2 describe the study's purposes and the research methods used. Chapter 3 analyzes the education systems within the five countries--with special reference to education, training, and research in the textiles sector--and contains the case study analyses of the individual centers of excellence. Also in the third chapter appear descriptions of research, development, transfer of technology, and training initiatives taken by the EEC in the textile and ready-made clothing sector. The fourth chapter offers conclusions on the structural criteria for a center of excellence, operating criteria for such a center, the social system levels at which the center should operate, and the criteria for defining a center of excellence. The appendix examines the approach to technology transfer taken in the United States, from which the approaches taken by the studied countries differ. A list of organizations visited during the study concludes the document. (CML)

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Exploratory study of the role and activities of 'Centres of excellence' in the textile industry in four EEC Member States

European Centre for the Development of Vocational Training

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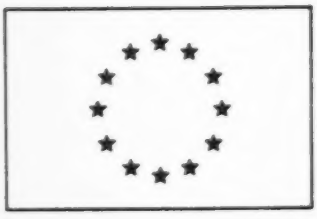

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Texilia, Istituto per la tradizione e la tecnologia tessile SpA

First edition, Berlin 1988

Published by:

CEDEFOP — European Centre for the Development of Vocational Training
Bundesallee 22, **D-1000 Berlin 15**
Tel. (0 30) 88 41 20; Telex 184 163 eucen d;
Telefax (0 30) 88 41 22 22

The Centre was established by Regulation (EEC) No 337/75 of the Council of the European Communities

This publication is also available in the following language:

IT- ISBN 92-825-8937-4

Cataloguing data can be found at the end of this publication.

Luxembourg: Office for Official Publications of the European Communities, 1988

ISBN 92-825-8936-6

Catalogue number: HX-53-88-366-EN-C

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Printed in Belgium

Introduction

In this period of technological progress and on-going restructuring in the Textile/Clothing Sector technology transfer is taking on increased significance as far as products and management are concerned.

It is also becoming clear what an important role vocational training is being called upon to play, with, on the one hand, its established links with basic education and research and its provision for the needs of the labour market and the production system, on the other.

The purpose of this study is to provide a critical analysis of the responses of various member states of the European Community to the two areas of needs referred to in the above. The study aims to examine the responses, which have taken shape within each member state in the national context and the role played by both the public and the private sectors in the economy and in education.

We have designated the various institutions, who have undertaken to implement the transfer of technology in the different member states, even at the level of the small and medium-sized enterprises, "centres of excellence". Their role covers a range of realities, which may exist within the bounds of one and the same member state.

Thus, we would contend that a "centre of excellence" is a forum which, over and above providing training and maintaining its links with the labour market, carries out research and disseminates technology with particular reference to research and information projects involving not only individual firms or groups of firms, but also, if possible, the textile industry as a whole.

This study aims at enhancing the awareness of groups of interests within the branch in different member states of the Community and at promoting cooperation between them with a view to solving the problems on hand.

The approach which has been chosen is one based on case studies involving the use of questionnaires and interviews with the administrative and economic experts at each institution and analysis of the services offered. In this context,

we emphasize the specific characteristics of each centre and assess transferability potential in geographical terms and in terms of the branch in question.

The countries covered by the study are ones where the textile and ready-made clothing industry is already developed and well-established and where there are advanced structures for providing the sector with training facilities, technological research and information in an integrated fashion.

The first part of the study is devoted to a brief analysis of the various education systems, with special reference to education, training and research in the textiles sector.

The second and main part of the study, on the other hand, focuses on analysing the different forms taken by the "centres of excellence".

Subsequently, a brief description is given of the initiatives taken by the European Community in connection with research and dissemination of information in respect of the textiles and ready-made clothing sector.

This is followed by an assessment of the prerequisites for cooperation between member states with a view to establishing an "integrated centre of excellence". The benefits of such a system are then pointed out along with the problems connected with it.

Reference is made in the annex to technology transfer in the United States, where the approach adopted to this in the sector is structured differently than that found in the countries examined in the study.

Finally, there is a completely up-to-date list of organizations visited to assist readers in establishing direct contacts.

This study is part of a project being conducted by CEDEFOP on the role of education and training as a vital ingredient for the successful restructuring of different branches of industry/services in the EC member states in the Mediterranean area in the light of the approach of 1992 and

the " establishment of the single European market" aimed at permitting the free circulation of manpower on the "European labour market" and "social and economic cohesion" to even out areas of regional and sectoral inequality.

CEDEFOP, Berlin, May 1988

Tina Bertzeletou
Project Coordinator

Corrado Politi
Deputy Director

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1. INTRODUCTION - RESEARCH AIMS

Vocational training is of major importance during this period of technological advance in every sector of production; this is particularly true of the textile and clothing industry where vocational training is increasingly the indispensable foundation for:

- planned management of the labour market;
- the development of widespread professionalism, seen as the optimum use of in-house resources (expertise and ability) to control process variables and take appropriate steps to correct their divergences;
- more rational and rapid dissemination of technological innovations concerning products and processes.

Vocational training is also, therefore, an integral and particularly important part of "training and education" seen as the overall process by which individuals are brought together within organized social systems.

This aspect provides a fairly close link with basic education (State-run education from compulsory schooling to university). The link cannot and must not, however, be merely subordinate to the State education system (even if this is the case in some national contexts), but should rather promote those forms of synergy which alone can optimize the use of resources and maximize their impact on the social system.

From the structural point of view, this dual relationship

with the labour market and technological product and process systems and with basic education and training is resolved in a variety of ways in the Member States of the EEC.

These differences arise not only from the different situations of industry and therefore of the textile industry, but also from the specific features of the training and education systems of the countries involved and the many and complex historical and cultural factors which have for centuries shaped the history of the countries of Europe.

These major variations consequently make any analysis and interpretation of the range of vocational training situations in Europe very complex, and make the preparation of common training programmes or research and technological dissemination projects even more complex.

Administering ESF projects in a standard way has raised particular problems, with the result that projects are delegated to the individual Member States involved and the EEC keeps control only over the appraisal and assessment of projects which are generally evaluated without taking into account the structures which will put them into practice and in many cases merely carries out accounting checks which are often no more than formalities.

If progress is to be made with the creation of genuinely "supra-national" training systems integrated irrespective

of their geographical location, it is not possible to use a strategy which looks across the board at all the difficult issues which have up to now caused training activities to develop in a wide range of different ways: a method which could actually be used in practice would be to pinpoint a specific "case" within a sector which has a high level of comparability in the Member States of the EEC and where there is previous consolidated and "historical" experience of international cooperation.

The textile industry undoubtedly satisfies these criteria; the "case" against which the actual potential for integration, at both the operating and planning stages, among the Member States of the EEC could be assessed might well be the establishment of a model which lays the foundations for the development of technological innovations in production structures seen in geographical terms (comparable socio-economic sub-areas) and in sectoral terms (textiles), with predetermined levels of synergetic integration between basic education and training and research and the dissemination of technological and organizational innovations.

This conceptual model, which could be put into practice in terms of organization and operation, could well provide a reference framework appropriate to all national contexts from the point of view of operating methods, structure and functions and the actual content of training schemes and research and technological dissemination projects.

This theoretical model, seen in this research as the basis for a "Centre of Excellence", could provide the initial supra-national reference framework which goes beyond the simple definition of objectives and takes concrete shape in day-to-day operating practice.

The "Centre of Excellence" as envisaged is shaped by predetermined structural criteria (its constituent and interconnected agencies and potential synergy) and by operating criteria, linked closely with the methods used to identify, define, study/put into practice and monitor training schemes and projects for innovation and the dissemination of technology.

The aim of this research which is an initial study of the feasibility of the "Centre of Excellence" model is to bring together, assess and interpret those features which are characteristic of the various national contexts and which can be used to define a reference model which is as comparable as possible and can be put into practice in any country, even within the context of national constraints, when optimum predetermined structural and operating criteria are satisfied. A further task of this research is therefore to put forward a possible set of optimum structural and operating criteria against which potential Centres of Excellence can be assessed.

2. METHODS

The basic criteria for assessing potential "Centres of Excellence" include:

- structural criteria (the existence of specific basic education and vocational training agencies and facilities for research and the dissemination of technology within a comparable geographical sub-area);
- operating criteria (the existence of a genuine synergy between the activities of the agencies making up the Centre of Excellence as regards the implementation of training schemes and research and technological dissemination projects in the textile industry). These were also the main criteria used to select the sample of potential "Centres of Excellence" to be analysed.

The first step was to locate possible comparable socio-economic sub-areas given over predominantly to textiles in the four countries covered by the research (France, United Kingdom, Federal Republic of Germany and Italy); these areas were then analysed to find out whether or not they satisfied the structural criteria with an additional assessment, in some cases, of operating criteria.

Case studies were selected with the aim of providing a qualitatively significant example of the optimum criteria which Centres of Excellence could be expected to meet.

The first stage of the research was to send out a questionnaire so that a vast number of situations with the

potential to be Centres of Excellence could be analysed; the small number of questionnaires returned, despite numerous requests, made it necessary to base the final choice of case studies on the criterion of optimum structural criteria shown by documented data characteristic of each sub-area.

Operating criteria were difficult to assess and there was a considerable degree of uncertainty in many cases; these criteria were not, therefore, taken into account in the choice of the sample.

To provide a detailed definition of operating criteria and look in more depth at structural criteria, field research was carried out in the form of in-depth interviews.

The information gathered is analysed in Section 3.2. of this report and is the basis for the discussion contained in Chapter 4 (Conclusions).

3. ANALYSIS OF NATIONAL CASE STUDIES

3.1. General comments on vocational training structures in the four EEC Member States analysed

The education and training systems of the four Member States from which the Centre of Excellence case studies have been taken will be summarized in the following sections of this report.

A description of the framework within which the various agencies involved in education and training systems operate should make it possible to highlight some of the parameters which define whether or not centres can actually be considered as Centres of Excellence.

Reference is made to the following parameters in particular:

- links/integration with public and parapublic research centres,
- integration with the State education system,
- integration with school guidance systems and systems to find work (for school leavers and unemployed workers) in the labour market,
- technology transfers.

The impact of these parameters on the features of the various Centres of Excellence can be fully analysed and "evaluated" only if they are "calibrated" with respect to the various national contexts.

3.1.1. **France**

a. General comments

The French education and training system must be viewed in terms of the three basic channels which shape the vocational skills of workers:

- State education,
- organized training,
- apprenticeship/on-the-job training

at two levels:

A. basic training,
B. continuing training.

At level A the State education channel and to some extent that of organized training come into play; at level B organized training and in particular apprenticeship and on-the-job training are used.

This configuration allows for close integration between the various education and training facilities, in the first case between State education (at its various levels) and vocational training and in the second case between training and the production system.

In basic education, over and above general education appropriate to society as a whole, training targeted around specific "areas" of technology is also given. If there is alternance between school and work at this stage,

it is predominantly a teaching resource designed to achieve both overall "educational" aims (related, therefore, to society as a whole) and "cognitive" aims relating to specific contexts (the goods and services production system, i.e. companies).

The use, during this initial stage, of alternance as a way of placing young people in their first jobs or finding jobs for the unemployed, has less of a place in the second stage (continuing training) but is nevertheless its main aim.

Continuing training therefore comes after basic education, relates to specific company situations and thus specific occupations and predominantly involves workers who already have jobs, but also has a significant supporting role to play in helping young people to find their first jobs in the labour market.

b. Structure of the training system

Basic education

After nursery (3 years) and primary (5 years) school, the French basic education system includes 4 years of lower secondary education from which students can go on to higher education institutions.

This system begins to branch out at the end of year 3 of lower secondary school, when less capable pupils are

channelled into the apprenticeship school stream (3 years), which includes various types of alternance between school and work and the award of the CAP (certificate of vocational aptitude).

There is a further branching out at the end of year 4 of lower secondary school, when pupils can either be channelled into a short technical training cycle (1 or 2 years at a vocational education lycée) or into upper secondary education which is in turn split between lycées and technical lycées.

In addition to the CAP, vocational education schools award the Brevet d'Enseignement Professionelle (BEP - Diploma in Vocational Education) relating specificially to the service sector.

From lycées students move on to universities and the "Grandes Ecoles" (a total of 7 years) and from technical lycées to university technical institutes (IUT) (2 years). Diplômes universitaires de technologie (DUT - University diplomas in technology) are awarded at the end of university institute courses.

The technical lycées give two-year courses as well as the three-year upper secondary course leading to the award of the Brevet de Technicien Supérieur (BTS - Higher Technician Diploma).

Like other education systems, the French basic education

system makes provision for technological and technical training (in common sectoral areas) at various levels ranging from the certificate of vocational aptitude for apprentices to university diplomas in specialized higher education studies. These correspond therefore to different professional resources used at different stages in the goods and services production and supply cycle, giving concrete shape to a range of occupations and thus also to different "qualifications" governed by contract.

This chain of correspondences which, in contrast to other EEC Member States (such as Italy), is strictly regulated by law, leaves little room for collective and/or individual bargaining with the result that training facilities play a significant institutional role in the system used to define professional skills.

This role is even more substantial in the case of highly integrated systems such as the Centre of Excellence system and highlights the way in which this system differs from other national systems in the EEC which are not as systematic and do not have the degree of institutionalization which distinguishes the French education system.

Continuing training

Continuing training is organized and systematic, although allowing for a range of objectives and operating conditions (flexibility and widespread availability within

production structures) and is organized along similar lines to basic education.

Training schemes are highly targeted and may be carried out either directly by the firms involved or by specialized outside public and private institutions.

The Institute for "Congé de Formation" (study leave) arranges for school and work alternance which may be additional to participation in training courses organized as part of the annual training plans of the individual firms to which workers belong.

c. Structure of the training system in the textile industry

Technological and technical training in the textile industry is imparted at all levels of the national training system, with a high degree of vertical integration so as to provide for the creation of an organic system of sectoral training which provides a response to all the job-skill needs expressed by firms.

Training activities as a whole can be broken down into six levels:

Levels 1 and 2: corresponding to the basic training imparted at universities and in particular at schools of engineering;

Level 3: corresponding to the basic training obtained at university institutes of technology (DUT) or on two-year higher technical training courses following on from technical lycées (BTS);

Level 4: corresponding to the basic training obtained at technical lycées (technical baccalauréat, BTn);

Level 5: corresponding to the basic training obtained at vocational lycées (lycées d'enseignement professionnelle) with qualifications such as the Brevet d'enseignement professionnelle (BEP - diploma in vocational education) or the Certificat d'aptitude professionnelle (CAP - Certificate of vocational aptitude).

In the continuing training system for adults level 5 corresponds to level 1 of the Certificat de formation des adultes (CFPA - Certificate of adult training);

Level 6: corresponding to the basic training imparted by the end of the first cycle of secondary education (first three years) supplemented by 1 or 3 years of apprenticeship-oriented training.

In substance, French universities and schools of engineering provide basic training for company managers, university institutes of technology and technical lycées train technicians working at various stages of processes and vocational schools for apprentices train skilled and unskilled manual workers (Table 1).

Table 1

Level			
I/II	Executives Managers	Universities Schools of engineering	
III	Technicians	University Institutes of Technology	(DUT)
IV	Technicians	Higher Institutes of Technology (Technical lycées)	(BTS)
		Technical lycées	
(CAP/BEP) V	Skilled Workers	Vocational lycées	(BEP)
VI	Unskilled workers	Apprenticeship schools	(CAP)

The differences contained in the French system therefore relate almost exclusively to the sector of production (textiles, mechanical engineering, electrical engineering, etc.) and the stage of involvement in the cycle (manager, technician, manual worker); there do not appear to be differences as regards functions of the cycle (sales, engineering, design, etc.) while it would seem from the detail of the "Diplômes professionnels textiles" (vocational textile diplomas) that there is a detailed breakdown by types of technology or by the levels of work involved in these technologies.

France has a total of 13 schools authorized to award vocational diplomas at levels I, II and III in the textile industry; 5 of these are schools of engineering, 1 is a research and training institute providing engineers with specialist textile skills, 3 are university institutes (IUTs) and 4 are higher lycées for textile technology (BTS).

At levels IV and V there are 26 centres with 13 specializations. Student numbers in each specialization often vary substantially and in many cases seem to be a response to precise "orders" from the production system.

Centres usually take the form of vocational lycées or training centres organized along similar lines.

d. Research and technology transfers

General comments

On the basis of the model developed in this report, the other assessment criterion for Centres of Excellence, over and above training and its relationships with the labour market, is research and the dissemination of technology, particularly research and dissemination projects which do not simply involve individual firms or groups of firms, but the textile industry as a whole.

In France, most of these criteria are brought together within a specific structure: the "Institut Textile de France" (ITF - French Textile Institute). As in the case of training, activities in this area in France are organized in a systematic and organic way making use of specialized facilities (and therefore specific human and material resources) with planned activities which go beyond the specific interests of individual firms.

Structure and activities

ITF is regulated by Law 48 of 22.7.1948 which sets out its main aims: "to promote technical advances and contribute to quantitative and qualitative improvements in the efficiency of production cycles".

The channels throug which these general aims are to be achieved include laboratory research and experimentation

in experimental production departments, participation in production process and quality control standardization, as well as all the activities which follow on from this such as disseminating findings so that the workers which they affect can be informed and updated and providing training for workers in specific occupations.

The ITF has 3 subordinate centres and 4 affiliated centres located in the main areas in which the textile industry has developed in France; these centres provide permanent work for 400 people including researchers and ancillary staff.

ITF facilities can be divided into 3 main groups:
- laboratories (physicochemical, optical, mechanical engineering, etc.);
- experimental production departments (spinning, weaving, finishing-dyeing, make-up, etc.);
- plant and production machinery research offices (mechanical engineering, electronics, automation, computing, etc.).

Groups of associated companies are linked with each of the 7 centres and appoint representatives to serve on Groupes de Travail (GT - Working Groups) or Commissions Techniques (CT - Technical Committees). These groups, which meet twice yearly, provide a forum for the discussion and formulation of ITF's working plans both at national level and for each individual centre. Some research and experimentation projects may be of local or sectoral

interest, while others may be brought together and managed at national level, coordinating and making the most suitable use of contributions from the individual centres.

There are currently 48 GTs or CTs bringing together 580 technicians representing the industries associated with the 7 ITF centres. Coordination of the proposals drawn up by GTs and CTs and the preparation of the annual working plan is the task of the ITF's General Committee. In addition to working group and technical committee coordinators, this committee includes representatives from both sides of industry and from the public authorities, the directors of the 7 ITF centres and the general directorate of ITF itself. The ITF's Management Board is responsible for validating the plans worked out in this way.

Activities carried out up to now have touched on almost all aspects of production processes in the textile industry:

1. Quality and reliability
   - quality in production
   - certification of quality
   - costs of defective quality
   - costs of defective reliability

2. Automation
   - transducers
   - automation of dyeing

- automation of make-up
- process computerization

3. Control of technological variables in production
   - development of methods and instruments for process control in production departments
   - process improvements
   - new process technologies
   - new product technologies

4. Optimization of raw material and energy uses
   - optimization of raw material uses
   - energy savings

5. Reduction of pollution
   - treatment of liquid effluents from the textile industry
   - techniques for measuring the dust present in production environments

6. Recovery and re-use of textile by-products and similar materials

7. Basic research

8. Documentation

9. Techniques for technological information and the dissemination of innovations

10. Production of standards

In addition to these 10 projects the ITF is working on a scheme to provide services for firms in the industry in four main areas:

1. Technical assistance
2. Analyses, laboratory tests and inspections
3. Training
4. Information and documentation.

These services, broken down into the 4 areas, may also be provided if individual firms request them; in such cases a "private" contractual agreement is set in motion between the firm making the request and ITF. Activities of this type account for a substantial proportion of ITF's work.

Conclusions

The way in which ITF is structured is in keeping with the general approach within the French system to promoting the development of the production apparatus, from the point of view of both human resources (training) and technology (research and dissemination of technology). As regards the outline of a possible "Centre of Excellence" model, the French experience obviously has much to contribute as regards the systematic and rationalized nature of the activities of centres.

These aspects will be analysed in greater detail in the two case studies ("Mulhouse" and "Troyes") discussed below

in Section 3.2. "Analysis of the qualitative sample of Centres of Excellence".

3.1.2. United Kingdom

a. General comments

The British education system appears to be one of the least rigidly structured as regards both basic education and continuing training. Course structures tend to reflect the elasticity and flexibility needed to meet changes in the demand for training and education from society as a whole and the need to ensure a minimum standard of high-level free education for all inhabitants. In order to meet this dual requirement the British system has, on one hand, a number of education and training facilities (public and private schools subsidized to varying extents and therefore with varying degrees of autonomy) and, on the other hand, an organic framework of examinations run by independent examining boards which administer the system in an "objective-based" way, where the objectives are chosen by pupils when they select a personalized curriculum centred not so much on specific schools but on specific courses.

If this system is to work, it needs a large number of educational facilities, some specializing in the identification and correction of curricula shown to be either mistaken or no longer practicable.

These are facilities such as the Open University, distance learning and higher education courses.

The sole, although major, areas of inflexibility in the system, from the point of view of its facilities, are to be found at either end of the system, at the beginning of the school cycle and its end, in the Universities.

In the first instance, these take the form of regulations which make free schooling compulsory between the ages of 5 and 16, and in the second instance they derive from the absolute autonomy over education and culture possessed by the Universities which are not therefore just assemblies of "courses", but genuine, organically structured, institutions with their own specific educational and scientific "projects" and their own personalities or in many cases their own "historic" cultural features.

This also means that vocational training is highly deregulated and is to a large extent delegated to user firms and supervised, to an increasingly small extent, by the ITBs (Industrial Training Boards).

Vocational skills and their related training curricula are thus defined in a very "personalized" way both from the point of view of the individuals involved (in the various stages of basic education) and from the point of view of firms (at the stage of continuing training in the production system): the task of the authorities is to ensure that the necessary resources (public and private)

are available and to check that objectives (training) are being achieved in certain crucial areas of the curriculum, via the examination boards and the award of the GCE (General Certificate of Education).

This situation, while able to meet change head on, does not seem to promote, except perhaps in the university "seats", the establishment of organically structured systems with permanent and consolidated training institutions comparable to those which are typical of the French system of education.

b. Structure of the education system

Basic education consists of primary school (6 years) from 5 to 11, lower secondary school (5 years) from 11 to 16 and upper secondary school (2 years) from 16 to 18. Students can then go on either to university (7 years) or university level higher education colleges (3 years) or polytechnics (3 years).

Different routes can be followed before the end of upper secondary school; students leaving lower secondary school (at 16 when compulsory education finishes) can attend courses organized by Institutes of Further Education (up to 5 years) and apprenticeship courses given both by special training centres and within firms.

The GCE system contains two hurdles which have to be overcome: the first (Ordinary Level) taken at the end of

the lower cycle of secondary education and the second (Advanced Level) taken at the end of the upper cycle of secondary education.

There are no particular restrictions on examination candidates (apart from minimum ages of 16 and 18). Separate results are given for each subject (there is no overall assessment) and subjects are classified as O or A Levels (depending on the level of the examination). Results are used as a criterion for university entrance examinations and as a criterion for finding a job.

Minimum standards, both in terms of examination results and the type of subjects passed, change in response to developments in the needs of the socio-economic system.

At present, in order to satisfy university entrance requirements, students must in theory have passed at least two A Level and 3 O Level examinations; in practice, however, given the high demand for places, at least 8 examination passes are needed, including 3 A Levels.

Vocational training is carried out through the further education channel after the age of 16 and through apprenticeship courses both within and outside firms.

Further education was introduced by the General Education Act of 1944 and is coordinated at county level by local authorities in the form of LEAs (Local Education Authorities). The structure of training in further

education is organized on an individual basis and is further broken down into modules.

Course levels range from basic technical courses to university courses. Training may be full-time or part-time, in the form of alternance training or daytime or evening classes. There are no age limits once compulsory education has been completed at the age of 16. An examination is usually taken at the end of a course; the content of examinations and examining boards are formulated and administered nationally. Institutes organizing further education courses take a variety of forms: polytechnics, colleges of technological education, colleges of technical education, business schools, art colleges, agricultural colleges, the Textile Institute, the Society of Dyers and Colourists, etc.

Course outlooks vary greatly, depending on the individual institute and in particular on the local authorities (LEAs); they may have direct outlets into the labour market, or may make it possible for students to catch up on the basic education needed for university entrance by preparing them for GCE O and A level examinations, or may be genuine university courses for instance in schools of engineering.

c. Structure of the training system in the textile industry

The way in which training is structured in the textile

industry is largely due to the special position of the British textile industry, formerly the greatest in the world and still among the leaders. Despite far-reaching changes in the structure of the industrial labour market (supply and demand), in particular in the textile industry, firms still play a major role in training and the subsequent placement of trainees.

Training is available at all levels in the industry, from the highest (university) to training for apprentices after lower secondary education.

Universities

The departments of textile studies of the universities of Leeds and Manchester represent the best in the industry both as regards the present standard of studies and the prestige and authority traditionally conferred on them.

Two other universities specializing in textile technology supplemented these two departments in the 1960s: Strathclyde in Scotland and Bradford in England.

There are also a number of departments offering courses on textile industry subjects in other universities which do not strictly specialize in textile technology, such as the Schools of Economics in Manchester and Sheffield and Loughborough University which has developed a specific course on textile machinery.

Other university departments where studies are centred chiefly on polymer chemistry have sections specializing in synthetic fibre research. The same applies to dyeing, with important research divisions in a number of universities which, although they do not specialize in textiles, can therefore be added to the institutes in Leeds, Manchester and Bradford.

Polytechnics (Degree courses)

Polytechnics, as well as universities, offer degree courses centred on the textile industry; courses at the Polytechnics of Leicester, Trent (Nottingham) and Huddersfield are of particular note. In all three cases, specializations are centred both on functions of the textile cycle, including textile design and fashion, marketing, production engineering and on types of product, including knitwear and woven fabrics.

Courses are generally organized as "sandwiches", with students being placed in industry for part of the course.

Degree courses in textile design and the study of fashion are offered by other Polytechnics which do not specialize in textiles. Courses of this type are also offered by some art schools such as the London School of Art.

It is also possible to study industrialized garment make-up technology as part of certain textile technology courses.

Some Polytechnic programmes also include management courses for the textile and garment industries as part of undergraduate or postgraduate courses. Operators in the industry (managers and technicians) feel, however, that the number of courses in "textile design" and "fashion" (many more than are necessary) far outweigh the number of management and production engineering courses which are unable to satisfy demand and are in particular failing to meet the current requirements of the British textile industry.

Postgraduate studies and research

All the universities with textile studies departments offer postgraduate courses leading to the award of postgraduate diplomas or MAs. Postgraduate courses seem to be structured in two main ways:

- advanced training building on connected undergraduate courses:
- conversion from other non-textile subjects to textile studies.

The subjects covered by these courses include the study of textile technology, the study of fibres, etc. There are also courses where the focus is on the design of both textiles and of clothing and knitwear. Research carried out in universities and polytechnics is closely linked to postgraduate courses and acts as a basic educational channel for the award of PhDs or MAs; it does not seem, however, that it is of equivalent importance and use in

extending the frontiers of applied scientific and technological research for the textile industry.

Applied industrial research is generally left to appropriate associations (WIRA, Shirley Institute, HATRA, etc.) where reforms are currently under way to provide such associations with a greater margin of self-financing through the sale of services.

3.1.3. **Federal Republic of Germany**

a. General comments

The schooling, basic education and vocational training system in the Federal Republic of Germany is largely administered by public agencies and is coordinated with full autonomy by the individual Länder (Federal States) under general outline regulations passed by the Federal Government.

The basic education and vocational training systems are closely interconnected: specific vocational training paths follow on from each of three main channels of basic education.

Following the lycée channel (primary school, lower and upper secondary school), students can attend university courses (7 years) or university level higher vocational institutes (3-4 years), both of which deal with clearly defined and targeted "occupations".

Following the modern secondary school (Realschule) channel (primary school, lower secondary school, 6 years) students can enter complementary vocational schools where they can acquire a specific vocational qualification through the technical school-leaving certificate (2 years).

Finally, following the traditional secondary school (Hauptschule) channel (primary school, lower secondary school, 5 years) students can enter various types of vocational training and apprenticeship (3 years).

Higher university level courses (3 years) are available to students from both the Realschule and Hauptschule channels.

Vocational training also includes a further group of courses closely linked to the firms which make use of them (the "dual" system) where training is compulsory and free of charge and is a way of placing young people in their first jobs. The fact, in this case, that part of the training must actually take place in firms, limits the possibilities of action by firms in terms of the jobs available and thus the actual absorption of the labour market.

In-service training as well as "dual training" (designed to place young people in their first jobs) is undertaken by a further specific structure, "continuing training", where the aim is to develop and improve the vocational skills of workers throughout their working lives.

In the German vocational training system, both as regards vocational training which is closely linked to basic education (lower secondary school) and vocational training integrated with production structures, qualifications are seen as rigidly defined points of reference which can be modified only if this is decided at central level. Viewed from the outside, the main feature of the German system seems to be the way in which vocational skills are defined to cover all the needs of the goods and services production system. The path via which each skill can be obtained is defined in detail, the characterization of this path being, in contrast to the British system, an integral part of the vocational content of the skill. The "continuing training" system also has to be defined in terms of its objectives (updating and/or vocational advancement) and its instruments (and centres authorized to give this training).

In contrast to the British system, the German system offers qualifications which are clearly defined in advance; potential students can choose the qualifications towards which they want to work, while the instruments required to achieve these qualifications (training facilities) follow on closely from the qualification selected and are therefore compulsory.

In the Federal Republic of Germany, the training curriculum and qualifications are highly interdependent both as regards vocational training given as part of State education and in training integrated with the production system.

b. Structure of the basic education system

Delegation of powers over education to the individual Länder means that compulsory schooling lasts in most cases for 9 years (4 years of primary school and 5 years of lower secondary school) with some exceptions (Berlin, Bremen, Hamburg, North Rhine-Westphalia) where it is 10 years.

There are three different types of lower secondary school: the first type (Hauptschule) ends with the compulsory education period and lasts 5 years; the second type (modern secondary school, Realschule) lasts 6 years, i.e. one year beyond the compulsory education period; the third type, closely linked to the three-year lycée period (upper secondary school), lasts for 6 years after primary school.

After the lycée, students enter university faculties and other higher education establishments.

It is possible to go on from the other two types of secondary school only to the two- or three-year courses at technical or vocational schools (complementary vocational school, higher vocational training school awarding a school leaving certificate in technical studies, specialized schools for technicians and paramedics, etc.); from these schools students can go on to university level courses (3 years) in specialized technical subjects. This system makes it necessary for families and young people to

make binding choices at a very early stage, in practice after only 4 years of primary school.

Although students can in principle change from one type of secondary school to another, such transfers are difficult because syllabuses in the various types of secondary school vary considerably. Experimental "comprehensive" schools bringing together all three types of lower secondary school have recently been set up in an attempt to find a solution to this problem and make a gradual choice possible; this choice can be made during the 5th and 6th years of secondary school during the two-year "orientation" period.

Vocational training

Vocational training is based on an organic system of standard vocational qualifications defined and updated at Federal level; training curricula make use of both full-time technical and vocational schools, closely linked to the lower secondary schools, and the so-called "dual training" system with part-time, and in some cases full-time, courses closely linked to periods of apprenticeship and on-the-job training in firms.

Although "dual vocational training" is deemed compulsory for young people looking for their first jobs, the limited number of trainee places available in firms raises major problems. These problems are to some extent borne out by the creation of divisions/laboratories for apprenticeship

and on-the-job training where the practical component of the dual training system can be carried out on behalf of firms with a shortage of in-house trainee places.

There has been a trend, recently, towards increasing integration of the two components of the training (theoretical and practical):

- with the creation in the major firms of genuine training centres where the practical component can be undertaken and the theoretical component taught in outside schools can be supplemented or started afresh in cases where it has not been satisfactorily taught;
- and the creation outside firms of inter-company "training centre" firms which give the whole training cycle (technical and practical) and draw on the experience of the firms belonging to the joint venture for the practical component.

These comments show that improvements to the standard of on-the-job training are a current problem in the Federal Republic of Germany and that the dual system can provide excellent results if its undoubted advantages at the "educational" level are exploited, but that its results are not always satisfactory when it leads to training facilities which have little contact at the institutional level, particularly when major technological product and process innovations need to be introduced and training requirements are greater and need a high level of integration between theory and practice and cannot therefore be identified with the traditional craft trades

where aspects of theory relevant to practice were limited and had little to do with actual practice.

c. Structure of the training system in the textile industry

There are direct links in the textile industry, as in other sectors, between the vocational training curriculum and qualification levels; these are divided into 6 levels:

Level 1: Textile machine operator: 2-year full-time training course after lower secondary school, or two years of dual training using training/employment contracts.

Level 2: Textile mechanic: 1-year course after level 1 training, either full-time or under the dual system.

Level 3: Textile industry specialist: 2 years following the upper vocational school level alternating with practical experience in firms.

Level 4: Textile technician: 2 years at a technical institute, after the upper level, supplemented by specific practical experience in firms.

Level 5: Technical and vocational textile engineering diploma (Dipl. Ing. FH): 3-4 years of university level courses after high-level vocational school (2-3 years).

Level 6: Technical diploma in textile engineering (Dipl.

Ing. TH): 5 years after the technical school-leaving certificate (Abitur) and specific practical experience.

Basic education in the Federal Republic of Germany is predominantly given at the compulsory education stage and, to some extent, in technical schools which award technical school-leaving certificates, while vocational training is given at subsequent levels, either full-time with specific vocational experience or with the dual system.

Level 1 covers unskilled workers (level 6 in the French system), level 2 covers skilled workers (level 5 of the French system), levels 3, 4 and 5 cover technical production operatives at various levels (levels 4 and 3 of the French system) and level 6 covers process technicians and supervisors and company managers (levels 1 and 2 of the French system).

Some reference occupations (included in the national register of qualifications) and their related training curricula have been laid down in detail for levels 1 to 3.

1. Spinning

Level 1	Level 2
Textile machinery operator (spinning)	- textile spinning mechanic

2. Weaving

Level 1	Level 2
Textile machinery operator (weaving)	- textile weaving mechanic - textile weaving mechanic for tapes/ropes - weaving design programmer

3. Knitwear

Level 1	Level 2
Knitwear machinery operator	- textile weaving and knitwear mechanic - textile mechanic for hosiery and fine hosiery

4. Finishing/Dyeing

Level 1	Level 2
Operator of textile machinery for finishing and dyeing	- Dyer - Printer - Finisher - Smoother

5. Clothing

Level 1	Level 2	Level 3
- garment sewer	- garment maker	- garment cutter

d. Research and technology transfers

General comments

In accordance with the model put forward in this report, the other assessment criterion for "Centres of Excellence", over and above training and its relationships with the labour market, is research and the dissemination of technology, with particular reference to research and dissemination projects involving not just individual firms or groups of firms, but the textile industry as a whole.

The Federal Republic of Germany has a permanent system (AIF) for cooperation between textile industries and research centres for the development of specific research programmes and their subsequent dissemination.

Structure and activities

As in the case of other applied research activities, 3 separate agencies are involved in applied research in the textile industry:

- the firm or firms identifying the problem which could be the basis for a research project via a committee of technicians;
- the management board and the relevant technical and scientific committee of the association (AIF);
- the research institute chosen to carry out the research.

The first agency (the firm) identifies the technological problem (relating to a process and/or a product), the second agency formulates it as a possible research project and the third agency drafts a detailed research project proposal which, if approved by the first two agencies, undertakes the project issuing periodic updates on any interim findings which can be put into practice and can be disclosed within the production units interested in the innovation.

Work by the cooperative research associations which belong to AIF follows a standard procedure.

Work is begun on the basis of a proposal for further study of a new technological problem; the initiative for this usually comes from firms or may come from one of the associated research institutes.

Technical details of the research topic are then discussed by the board of the professional group involved which formulates a possible research project proposal which is then passed on to one of the establishments belonging to the cooperative association which is competent to deal with the topic.

The research project proposal is examined and assessed by the technical and scientific committee of the establishment which includes representatives from the firms belonging to the cooperative association.

If the proposal is approved, further details are worked out, with the agreement of the professional group proposing it, and it is formulated as a genuine research project with objectives, deadlines, operating methods and costings.

The project is then examined by the management board of the cooperative association which appoints one of its members as a project officer who, after approval by the board, monitors the development of the project on behalf of the board, together with the professional group, the firms and the institute involved.

At this stage the research project becomes part of AIF's official programme and may draw on appropriate funds and receive any technical or legal assistance which may be necessary.

The project can be updated or modified while work is in progress.

Individual firms can also be directly involved in the project so that their machinery can be used or their specialist advice called upon. If the research findings are deemed satisfactory by all those involved (AIF's rapporteur and management board, firms and professional groups proposing the research and the research institute which has undertaken the work), it becomes part of the technology transfer and dissemination plan.

This plan is implemented jointly by AIF, in particular its textile committee, the professional group involved and the institute which has carried out the work.

Its dissemination is carried out in a number of ways, ranging from the updating of vocational training programmes to the organization of symposia or the creation of comprehensive technical documentation including journals, information circulars, summaries of research findings, etc.

3.1.4. Italy

a. General comments

The system of education and basic and vocational training in Italy is administered largely by public agencies, although privately run basic education and, to a larger extent, vocational training plays an important role.

Planning and administration of the basic education system (State education) is highly centralized, whereas vocational training management has for the most part been delegated to the Regions, which are able to work with considerable autonomy in their own areas.

The basic education and vocational training systems do not always complement one another, but often work in parallel, and with considerable autonomy, and therefore often with strong interconnections and mutual coordination.

Vocational training is not compulsory even for school leavers looking for their first jobs; course attendance is therefore voluntary, and the motivation to do so is often no more than subjective.

This shapes the range of courses available and means that priority is given to the subjective requirements of trainees rather than to the objective needs of the labour market. This lack of planning is exacerbated by the absence of labour market analysis organizations and agencies guiding young people in their selection of courses.

Innovative experiments in this area have been launched in only a few Regions and are still at the experimental stage.

The general intention of the new national (Law 845/1977) and regional legislation is to make vocational training an active instrument for optimum management of the labour market, shifting it away from its traditional parallels with State education (basic education); the failure, among other things, to implement upper secondary school reforms has so far, however, prevented the full implementation of the law.

The Italian basic education system is fairly standard at present, and those differences which do exist in upper secondary education have little effect on the choice of university courses which is more or less free and is not

restricted in any way.

The fact that upper secondary schools and universities do little to prepare students for professional life has promoted the grôwth of vocational training courses which attempt to "supplement" the two study cycles and help young people to find work, making use of work experience periods and training and employment contracts.

Formal study certificates which are standard throughout the country (lower and upper secondary school-leaving certificates, degrees) are awarded on successful completion of basic education and are in some cases a requirement when registering for entrance examinations for the professions (lawyers, doctors, etc.).

Students completing vocational training courses are awarded vocational proficiency certificates which vary from Region to Region, although they are in keeping with a single general outline prepared at national level by the Ministry of Labour. In some cases certificates are not issued after a formal examination has been taken, but take the form of attendance certificates.

Vocational training in Italy has little overall impact both quantitatively and qualitatively on the labour market system, although considerable progress has been made in recent years; moreover, the very wide range of conditions in which vocational training is carried out does not make it possible, as in other European countries, to put

forward a standard model of training which seems to have begun to take shape only recently in some Italian Regions.

b. Structure of the training system

Compulsory education currently lasts for 8 years in Italy (5 years at primary school and 3 at lower secondary school). A reform of upper secondary education which would increase compulsory education to 10 years (5 at primary school, 3 at lower secondary and 2 at upper secondary) has been in the pipeline for some years.

Lower secondary education is standard; options are therefore chosen at the beginning of upper secondary education when lower secondary education has been completed.

The current structure of upper secondary education is based on legislation which came into force before the 1940s, subsequently modified in part, without the long-awaited comprehensive reforms which have been announced on several occasions ever having been implemented.

Upper secondary education is structured around three general streams: lycées, technical schools and vocational schools: courses at all these schools last five years. Lycées are divided into "classical lycées" teaching literary and philosophical subjects, "scientific lycées" and "art lycées". Technical and vocational schools are split into many sectoral and/or professional

specializations and cover more or less all the technological and technical areas to be found in a modern socio-economic system.

Specializations are generally oriented towards product technologies and, much less frequently, towards process technologies; precise references to production functions and specific occupations are not in general to be found. Vocational training has been successfully introduced into this area with schemes for refresher training, advanced training and redeployment to meet labour market demand (this is the "higher level training" mentioned above).

Intermediate vocational proficiency certificates can be obtained only at the end of the third year of vocational schools. This certificate is parallel to and almost in competition with the lower level vocational training courses which normally last two years and in some cases one year.

No particular selection criteria are used for university and polytechnic (all of university level) admission: all that is needed for admission to any university or polytechnic faculty is an upper secondary school-leaving certificate or technical certificate (with the exception of some special schools such as art schools where aptitude is obviously important).

Higher education awards prior to the "dottorato" (equivalent to the degree in Britain) have not existed up

to now, although a higher award does exist, i.e. the research doctorate.

Under recent university reforms it will in future be possible to establish intermediate higher education awards at the discretion of individual universities and polytechnics which can set up "specialized higher education colleges" within but clearly separate from universities and polytechnics. This initiative parallels and to some extent overlaps those schemes (very few in number) for post upper secondary school vocational training lasting one or two years launched experimentally some years ago by certain Regional Authorities.

Vocational training

Vocational training in Italy is shaped by a number of factors which make its structure rather complex:

- historical factors: the lack of any national tradition of a standard vocational training model which goes beyond the training typically given in craft workshops has a particular impact;
- institutional factors: the fact that basic education (State education) and vocational training are run in a parallel way and do not complement one another is exacerbated by the large numbers of independent decision-making centres: central government for basic education, the Regions for vocational training;
- structural factors: such as the lack of a single system to define vocational skills and thus the lack of any

close links between training curricula and skills; attempts in recent years, following the outline law on vocational training of 1977, to define "bands of comparable skills and trades" to be used as an unambiguous reference for vocational training and the labour market, have not had a great deal of success up to now.

The lack of a rigidly structured vocational training system has not, however, just entailed drawbacks, but has paved the way for a number of high quality schemes run by public and private or mixed agencies which have often made use of particularly innovative types of training (such as training in process automation technologies, including CAD/CAM/CAE).

Vocational training in Italy is at present aimed at young people looking for their first jobs who have on average attended a full-time two-year course after completing lower secondary school, supplemented in some cases by specialist courses varying in length up to one full-time year, or who have attended other full-time 6-month courses after upper secondary school:

- at employed workers affected by production reorganization and/or the introduction of new technologies;
- at unemployed workers to help them to learn new skills more in line with the new developments in product and process technologies to replace skills for which there is no longer a demand in the labour market.

Courses for the last two types of vocational training user are structured in a variety of ways, generally to meet the specific needs of each scheme.

There are also major variations in the structure of courses aimed at the first category of user, i.e. young people looking for their first jobs, depending on the regulations specific to each Region. Some Regions have in fact abolished the two-year courses following on from lower secondary school in favour of job-oriented shorter courses based on employment and training contracts; other Regions in practice offer no organized public courses for young people with upper secondary school certificates which means that the only courses available are privately run with no public funding.

A particularly interesting aspect of the Italian vocational training system is the system of multi-purpose integrated training agencies which are often run by mixed public and private companies operating over the entire range of vocational training and in some cases (such as Tecnotex di Biella) incorporating applied technological research ventures.

c. Structure of the training system in the textile industry

The general constraints on basic education and vocational training in Italy have an impact on the structure of training in the textile industry.

Basic education

Basic education includes, at the upper secondary school level, technical schools which award "textile specialist" diplomas with specialized options in types of products (textiles, knitwear) and processes (dyeing, textile design, make-up).

Some interesting experimental ventures have been launched to update and develop new teaching programmes designed both to include the technological innovations recently introduced into the industry and to establish closer links with the production system.

The Polytechnic of Turin in very shortly to set up a "Specialized Higher Education Institute" operating in the textile technology field. This educational establishment at an intermediate level between upper secondary school and university, is to be located at Biella within the general context of the Città Studi project and in the district in which Tecnotex operates; high levels of integration with the latter are planned. A similar venture is being studied at the University of Florence. The Polytechnic of Turin runs a textile studies course, although there is no genuine specialization in the industry.

Vocational training

Vocational training in the textile industry is organized

along more or less the same lines as described above for vocational training in general: courses are in practice put on for young people looking for their first jobs after leaving lower secondary school. These courses are centred on specific or multi-skill (textile process operators) qualifications and last from 1 to 2 years full-time with work experience periods in textile firms. A study intended to give a detailed definition of occupations and standard courses valid for the Italian textile industry as a whole is currently nearing completion. This study has been prepared and coordinated by ISFOL (the national agency for vocational training coordination run by the Ministry of Labour) and the Emilia-Romagna Region; other regions where the textile industry is well represented such as Piedmont, Lombardy, Tuscany, Apulia, etc., have also taken part in the study.

Courses aimed at young people with upper secondary school qualifications have also been launched. These courses are intended to prepare trainees for specific occupations in textile design, the design, planning and management of production lines, the development and maintenance of plant and machinery and the laboratory analysis of raw materials and semifinished and finished goods.

The "Politecnico della Moda" (Fashion Polytechnic) in Florence which offers a two-year training course for designers and stylists is of particular note.

The advanced postgraduate course at the Scuola Superiore

Meccanotessile (Textile engineering college) linked to the CERIT Research Centre at Pordenone is of particular interest.

d. Research and technology transfers

The following public textile research centres are currently operating in Italy:

- two Experimental Stations (both in Milan) run by the Ministry of Industry working in the fields of silk and cotton and artificial fibres respectively;
- a CNR Research Institute at Biella for the wool industry;
- the Società di Ricerca Tecnotessile (Textile engineering research company) of Prato set up under the IMI fund for applied research, for projects generally of interest to a specific contractor;
- the CERIT textile engineering research centre at Pordenone.

In addition, analyses, studies and consultancy work are undertaken for firms in the laboratories and by the staff of the industrial and technical textile schools of Como.

There is, in practice, no coordination between these centres and schools, apart from some informal meetings within the Research Committee of Federtessile (Textile industry confederation) which does not, however, have any coercive or funding powers comparable for example to those of the German Kuratorium di Gesamttextil).

3.1.5. BELGIUM

a. GENERAL COMMENTS

1. The Belgian education system

The Belgian education system has recently been subject to reforms, some of which are still being put into practice, which have extended the compulsory education period to 12 years.

After Ecole Primaire (primary school - 6 years), pupils enter Ecole Secondaire (secondary school - also 6 years) which is normally divided into two three-year cycles (upper and lower); the "reformed circuit", on the other hand, includes three two-year cycles, known as "observation" (general preparation), "orientation" (foundation), and "determination" (final options).

In the conventional model, paths start to diverge in the upper cycle with options of the lycée type (classical humanities, classics and mathematics, classics and sciences, mathematics and sciences) and of the technical type: these include a textile specialization in some ten or so schools throughout Belgium.

Studies can be continued after Technical School at a level lower than university, following a two-year course leading to the award of "gradué" which is typical for example of laboratory workers; two Schools (Tournai and Ghent) offer

this possibility in the textile sphere.

Alongside the ordinary technical education described above, it is also possible to attend evening classes (for example three hours per day, four days per week over two years) leading to the award of technician diplomas, for instance in spinning, weaving, etc.

At university level, where entrance follows on from education of the lycée type, there are two Higher Education Colleges offering textile courses at Ghent and Verviers (main office at Huy) which offer four-year courses leading to the award of "industrial engineer"; after the initial two years (during which general subjects are taught) the award of "industrial engineering candidate" can be given, while specialist subjects are taught in the subsequent two years.

Some ten or so industrial engineers (mostly French-speaking foreigners) are currently graduating at Verviers and 30 at Ghent (almost all of Belgian nationality): it should be borne in mind that over 80% of the 60 000 workers in the Belgian textile industry are in Flanders.

At universities, which are distinct from the Higher Education Colleges, students can work towards the award of "Civil engineer" over 5 years; an industrial engineer can subsequently become a civil engineer by following courses over a further three years: this is very rare in the textile sphere, involving only 1-2 people per year at

Ghent. A civil engineer graduating in mechanical or chemical engineering can specialize in textiles by attending 1-2 years of postgraduate courses.

b. Vocational training

In the final two years of secondary school, pupils can satisfy the compulsory schooling requirement by choosing part-time teaching, along the lines of the German dual system: 2 days per week at school (50% general subjects and 50% vocational subjects), possibly at different establishments, and 3 days per week in firms.

In the textile area, with an estimated turnover of 3200 people per year, the aim of the programme (which has only just been launched) is to train 250 young people per year, thus involving 500 people over the 2 years planned. There are currently 160 employment/training contracts with firms: these contracts are advantageous for firms since the trainee enters into the contract not with the firm but with the Textile Industry Social and Guarantee Fund (financed by 0.25% of the wagebill) with no obligation on the part of the firm to employ the trainee subsequently; firms also receive FB 40 000 per pupil-year as remuneration for the services provided by their in-house trainer. Trainees receive some FB 160 per hour of work in the firm.

By far the most interesting activities as regards vocational training in textiles are carried out by CEFRET

(COBOT in Flemish), set up in 1984 by employers' and union organizations and recognized as a Training Centre by the National Employment Office: this Centre will be discussed in detail below.

The courses organized by CELAC (see below) should be mentioned among refresher training courses:

i. advanced training for unemployed laboratory workers, predominantly practical in nature, full-time for 13 weeks for 8-10 people twice a year (the course is free of charge and is funded by the public authorities);
ii. retraining of textile engineers, for the most part foreigners, over 4 months (course free of charge, funded by UNIDO amongst others).

c. Research

Collective textile research in Belgium is centralized at Centexbel which operates through the Ghent and Verviers centres; Centexbel will be discussed below in detail and we merely note here that Ghent has a staff of some 20 or so people and Verviers a staff of 15 (11 in the Physics Division and 4 in the Chemistry Division): Ghent specializes in short fibres (cotton) and Verviers in long fibres (wool).

Bearing in mind the definition of a "Centre of Excellence", it is particularly interesting to note that Centexbel has links with the Higher Textile Colleges at both Ghent and Verviers from the point of view of both

teaching and the preparation of research theses.

Theses are also prepared at CELAC where there is a reciprocal exchange with the Higher Education College at Verviers: CELAC loans its metrology laboratories and is able to use the College's processing departments.

d. Technical services to firms

Centexbel has set up a technology transfer service which is of major interest particularly as regards its network of link-people (10) which could provide a model for Europe as a whole: this will also be discussed in detail below.

Centexbel, on its own or in cooperation with CEFRET, organizes refresher seminars for managers and technicians (for instance, recent post-ITMA conferences). It carries out analysis and consultancy work at Ghent (the well-known De Meulemeester university laboratory is also located in Ghent), but not at Verviers: in the latter area, CELAC provides technical assistance for firms, including analyses for third parties (see below).

3. ANALYSIS OF NATIONAL CASE STUDIES

3.2.1. France

Troyes

Troyes, in the Département of Aube, is historically the centre of the French knitwear industry; the agencies operating in Troyes are therefore an example of both geographical and sectoral integration.

The main training and research establishments are as follows:

1. Institut Universitaire de Technologie (IUT - University Technology Institute) of Troyes (lower university education);
2. Lycée Technique des Lombards (pre and post baccalauréat secondary education);
3. Centre de la Bonneterie de Troyes (vocational training and technical assistance for firms);
4. ITF-Maille (research, technical assistance, technology transfers, continuing training for middle and top management).

The first three of these organizations are located quite close to one another which facilitates links (exchanges of teaching staff, provision of laboratories and in some cases joint preparation of programmes).

The agencies operating in Troyes satisfy the criteria for the establishment of a Centre of Excellence based on the model described above, since they provide, with satisfactory links between the various agencies, the basic functions of:

a. training (both State-run and vocational at various levels);
b. research;
c. transfers of technology.

A major shortcoming is, however, the absence of a university institution of a standard higher than the IUT (textile engineering).

Institut Universitaire de Technologie de Troyes
(rue de Québec)

The IUT (run by the University of Rheims) offers two-year post-secondary (Bac + 2) training courses of university level, on the following subjects:

- electrical engineering and computing for industry (with options in electronics and systems automation);
- mechanical production engineering;
- company management (with options in personnel management and finance);
- marketing techniques.

The IUT also organizes, on request, continuing training courses on the following subjects:

- management computing;

- financial and accounting management;
- international trade techniques;
- industrial computing;
- production science and automation.

The IUT has just launched a university diploma course (DUTH), which is the only one of its type in France, for the textile and clothing industry which has been developed in cooperation with professional associations (industrial associations and ITF-Maille) and the vocational lycée: the level of the course is Bac + 3 since a third year at the IUT supplements the two-year BTS course at the lycée.

Teaching is split between the IUT, the vocational lycée and industrial consultants and relates chiefly to general management techniques (administered by the IUT) and supplementary technological training: the course includes six weeks of work experience in firms.

The IUT has no textile laboratories but can use those of the vocational lycée.

Lycée Professionel des Lombards
(10-16 avenue des Lombards)

The Lycée offers courses leading to awards in the textile field at a vocational (BEP - CAP specializing in knitwear or textile finishing), secondary (BT - BP) or post-secondary (BTS) level.

It is important to note that industrial demand is increasingly for the post-secondary level (BTS) and therefore that there is a need for higher level training; it is for this reason that the lycée has agreed that the IUT should offer the third year mentioned above (DUTH).

In the continuing training area, which is provided for middle and top technical management by ITF-Maille in particular and for manual and skilled workers by the Centre de la Bonneterie, the lycée cooperates with informal exchanges of teaching staff.

Centre de la Bonneterie de Troyes
(10-16 avenue des Lombards)

The centre was established by local entrepreneurs (in the knitwear and make-up sectors) bringing together the former Apprenticeship and Production Centres.

The Board of Management includes representatives from industry (the unions are represented on the Conseil de Perfectionnement Paritaire (Joint Advancement Council) required by law).

Funding for this private agency comes from subscriptions from member firms, sales of services (courses and consultancy), the apprenticeship grant paid for the trainee-hours given to unemployed workers (the grant is reduced if the trainee fails to find employment, but the current rate of employment after courses is 93%) and

subsidies from the Ministry of Labour.

In addition to offering organizational advice to firms in the industry (particularly on issues connected with productivity), the Centre offers three types of vocational training:

1. Preparatory apprenticeship class (CPA): the Centre acts in this case as a host firm (since it has its own suitably equipped test laboratories) for students in the final year of compulsory education who have chosen to follow this path (50% of the school timetable).
2. Lower vocational training (workers): students are young people looking for their first jobs (who receive a minimum wage of FF 580/month), workers affected by redevelopment programmes (who receive 70% of their last salary), employed workers in continuing training (from 2 to 31 weeks full-time).
3. Higher vocational training (maintenance staff, setters, middle management), normally in the form of continuing training (in the case of future section heads for instance, 2½ years of 50/50 alternance between the Centre and their firm). Programmes, prepared annually, provide help with job-finding techniques (psycho-technical assessments, interviews, evaluation of professional skills) and include some forty or so courses chiefly in the area of knitwear make-up (cutting, make-up, maintenance and managerial training).

44 people, generally from industry, are employed by the

Centre. There are agreements with the Lycée des Lombards including the reciprocal use of each other's laboratories.

The consultancy services on organizational problems which the Centre offers to industry are an important factor in keeping the Centre up to date and ensure that it is constantly in touch with technological developments.

In the continuing training area, the Centre helps to organize work experience periods with the Association Nationale pour la Formation Continue dans le Textile (ANFOCOTEX - National Association for Continuing Training in the Textile Industry), 10 rue d'Anjou, Paris, set up by the Union Textile, unions and the ITF. The aim of this association is to undertake studies and prepare training programmes to improve continuing training in the textile industry and the way in which operating resources are used; it works in close cooperation with the trade associations and the training centres of the various regions, and itself prepares modern educational materials.

It also publishes surveys and periodical inventories of the supply of and demand for training in the French textile industry.

ITF-Maille (Centre de Recherches de la Bonneterie)
(270, rue du Faubourg Croncels)

This centre specializes in knitwear manufacture and make-up, a field in which it enjoys an international

reputation. In 1986 it had 76 employees, 28 at the engineer or higher technician level. The following breakdowns (1985) are of interest:

a. activities: 46% research, 17% activities of general interest, 6% promotion and free technical assistance, 31% provision of services;
b. funding: sales of services (32.4%), various subsidies (8.0%), public contracts (7.8%), parafiscal tax (42.5%). The percentage for the parafiscal tax is the lowest among those of the institutes affiliated to ITF which bears out the concrete nature of ITF-Maille's activities, since it manages to finance over half of its budget itself (as against approximately one-third for the ITF as a whole).

Research programmes are drawn up with the help of five technical committees including representatives from industry, most of which meet twice a year; these committees cover hosiery, knitwear finishing, pullovers, weaving and make-up.

Good results have been achieved from research at ITF-Maille in:

- the development of many instruments and measurement methods which have helped to improve the quality of knitted goods (device for measuring the length of absorbed yarn LFA, Cadratex, calculation of dimensional stability, comfortability measurements, etc.);
- the development of many machines (manufactured and sold under licence) particularly for automated make-up;

- major studies of both products and processes in the knitwear industry. ITF-Maille has always devoted considerable attention to the problem of disseminating the results obtained in its laboratories and has set up a specific agency (Sodemat) for technology transfers.

In the same way as other ITF agencies, ITF-Maille also carries out analysis and consultancy work for firms and offers a number of continuing training courses for technical managers.

Mulhouse

The overall system operating at Mulhouse (designed to serve the textile and textile engineering industry in Alsace) almost meets the criteria of the Centre of Excellence model, partly because of the excellent relationships between the various agencies and their respective managements teams, despite the fact that their legal status differs.

In this system:

1. all the required functions are brought together, at all the desired levels, including the advanced university level (with the possible exception of vocational training for manual workers);
2. use is made of agencies which belong to highly structured systems with the potential for cooperation outside the area as well (for example within the ITF network).

The major training and research establishments are:

1. Ecole Nationale Supérieure des Industries Textiles de Mulhouse - ENSITM (Higher National School for the Textile Industries of Mulhouse) (university education);
2. Vocational lycées (Lycée Louis Armand and Lycée Gay-Lussac) (secondary education);
3. Institut Supérieur Textile d'Alsace - ISTM (Higher Textile Institute of Alsace) (training of product managers);
4. Centre de Recherche Mécanique Appliquée au Textile - CERMAT (Centre for Applied Textile Engineering Research);
5. Centre de Recherches Textiles de Mulhouse - CRTM (Textile Research Centre of Mulhouse).

ENSITM

(11, rue Alfred Werner)

This School which is run by the Université de Haute Alsace offers a three-year training course for textile engineers (to which a make-up option has recently been added) requiring a DUT for admission (the final level is therefore Bac + 5).

Engineers awarded the diploma may go on to take a two-year diploma in advanced studies (DEA); students who then go on to prepare a research thesis over at least one year may be awarded the degree of doctor of engineering in macromolecular sciences.

Teaching is split into three main areas:

1. general scientific education (38% of the timetable): mathematics, physics, chemistry, mechanical engineering, etc.;
2. textile training (42%): fibres, spinning, weaving, knitwear, finishing, etc.;
3. "service sector" training (20%): languages, accounting, management techniques, etc.

Research can be carried out in the School (physics and textile engineering laboratories), during the work experience period in a company (students are placed in firms for at least two months of the third year) or in cooperation with the CRTM or CERMAT research centres.

The main fields of research are:

1. the mechanical, rheological and physical properties of textile and allied materials;
2. research and innovation in production processes;
3. the development of measurement instruments (for example the recent Yarntester);
4. study of the potential uses of technical textiles.

ENSITM has cooperated with foreign countries to develop higher education projects and programmes.

Vocational lycées

1. Lycée Professionnel Gay Lussac, 18, rue Gay Lussac;
2. Lycée Louis Armand, 3, boulevard des Nations.

The Lycée Gay Lussac runs CAP and BEP courses on textile treatment subjects (bleaching, dyeing, finishing), while the Lycée Louis Armand offers courses leading to the post-secondary BTS diploma in textile treatment.

ISTA (c/o Protextal, 6, rue de la Bourse)

This private institute was recently set up by entrepreneurs in the sector (belonging to the Protextal Association for the promotion of Alsatian textiles) together with three higher education and research organizations:

- ENSITM
- CRTM
- Ecole des Beaux-Arts.

The entry level is Bac + 2 (or in special cases appropriate experience in the indust) and training is given in three main strands over two years:

- artistic design,
- marketing and management,
- textile technology.

The training is intended to give trainees a new occupational profile, that of the product manager (chef de produits textiles), i.e. a general technical and commercial manager able to act as an interface between production and design and between the firm and its customers, for which there is a continuing demand in the industry.

CERMAT
(34, rue Marc Séguin)

This research centre is affiliated to the Centre Technique des Industries Mécaniques (CETIM - Technical Centre for the Mechanical Engineering Industries), an agency set up by the Association of Mechanical Engineering Industries of the Haut-Rhin Region as a regional support centre for firms chiefly, but not exclusively, in the textile engineering sector.

Areas of action include:
- mechanical and textile engineering research under contract;
- transfers of technology in areas such as production management, manufacturing methods, quality and maintenance;
- technical assistance on matters connected with metal and compound materials (analysis and consultancy).

CERMAT has fully equipped laboratories and may also carry out work within firms.

CRTM
(185, rue de l'Illberg)

This centre, adjacent to ENSITM (and the Lycée Louis Armand) in the university grounds, is affiliated to the ITF and specializes in textile finishing, sizing and cotton spinning and weaving.

It had a staff of 43 in 1986, 20 at the engineer or higher technician level.

The following breakdowns are of interest:

a. activities: 64% research, 11% activities of general interest, 41% promotion and free technical assistance, 21% provision of services;

b. funding: 22.6% sale of services, 6.6% various subsidies, 7.8% public contracts, 63.0% parafiscal tax.
The various items are in line with the average for the ITF.

Research programmes are drawn up with the help of three working groups consisting of representatives from industry which meet on average twice yearly and cover spinning, weaving and finishing. The main research results of CRTM include:

- research into spinning, particularly open-end spinning, and the effects of fibre properties on finished product quality;
- reduction of defects in woven materials and improvements in loom operation, including the development of measurement instruments suitable for laboratory and factory use;
- research (which is internationally recognized) into sizing;
- techniques to reduce power consumption;
- automated operation of a continuous dyeing line.

CRTM research is coordinated with ENSITM and CERMAT research through working groups which meet once a month and also act as an intermediary for the transfer of new techniques to industry.

Like other ITF institutes, the CRTM also provides analysis and consultancy services for firms and offers a number of continuing training courses for technical managers.

3.2.2. United Kingdom

West Yorkshire area

A large part of the British wool industry has historically been concentrated in West Yorkshire in the neighbouring cities of Leeds, Bradford and Huddersfield. This area is the headquarters of the Confederation of British Wool Industries (CBWT).

In addition to the Confederation's training department, other higher education and research establishments are of particular interest:

- Leeds University;
- Huddersfield Polytechnic;
- Bradford University;
- the Wool Industries Research Association (WIRA) in Leeds;
- the Technical Centre of the International Wool Secretariat (IWS) in Ilkley.

Although there are no formally established links between the various establishments, under the vocational training system, coordinated by the CBWT, it is possible, for example, in line with the typical British system, to obtain certain medium to high level awards by attending courses offered by universities and polytechnics on a part-time basis.

From both the geographical and sectoral points of view, the agencies present in West Yorkshire in principle have the functional elements needed for a Centre of Excellence, provided that closer coordination is established.

Confederation of British Wool Textiles
(60 Toller Lane, Bradford)

The Confederation is recognized by the Manpower Services Commission as a "non-statutory training organization" and in this guise coordinates - through its Training Department - the training of more than three times the number of higher technicians than were previously trained by the now defunct public Board.

It publishes the newsletter "Textile Training News" and an illustrated brochure listing the various careers in textiles open to young people leaving compulsory education at the age of 16: technical careers envisaged include the job of supervisory technician in various specialities (weaving, combing, worsted spinning, carding, carded spinning, dyeing) and courses last 4 years with alternance

between in-company work experience and part-time attendance of a higher education establishment (leading finally to awards of the BTech type).

The following are of particular interest:

1. the Textile Training Groups set up towards the end of the 1970s on the initiative of company managers who decided to group together to find joint solutions to mutual problems connected with practical and vocational training; these Groups, which are private but receive Government support, are acquiring increasing importance following the abolition of the Government Board. In Bradford and its surrounding area, the Group is active in four areas:
   - management,
   - techniques,
   - administration,
   - process operators.

   Training ranges from 2 weeks to 12 months for workers, up to 2 years for clerical grades and up to 5 years for higher technical grades: in the latter case, there are links with the part-time courses offered by Bradford College and Huddersfield Polytechnic, leading to the award of various types of diploma;
2. the Youth Training Scheme (YTS) which lasts, in Halifax for example, for 2 years with periods on the job in companies and off the job at Training Centres and (part-time) in the area's colleges (with the possibility of obtaining diplomas).

University level higher education establishments

Higher education in the textile field in the West Yorkshire area could be summarized as follows in 1985:

Institution	Diploma	Number of students	Features
Bradford University	BSc/BTech in Textiles	16	4 years "sandwich" (1 in company)
Huddersfield Polytechnic	BSc Textile Technology	25	4-5 years part-time
	BA Textile Marketing	107	4 years "sandwich" (1 in company)
	BSc Textile Design	86	4 years sandwich (1 in company)
	ATI Design	55	1 year full-time after BTech
	MPhil in textiles	2	
Leeds University	BSc in Colour Chemistry	58	3 years full-time
	BA in Textile Management	85	3 years full-time
	BA Textile Design	71	3 years full-time
	BSc Textile Chemistry	31	3 years full-time

BSc Textile Physics	1	3 years full-time
BSc Textile Process Engineering	4	3 years full-time
BSc Textile Engineering	2	3 years full-time
BSc Textile Industries	66	3 years full-time
MSc	10	3 years full-time
Postgraduate Diploma	12	
MPhil/PhD	45	

Part-time courses are also available for various degree awards, and in some cases part-time lower level courses (for an example of this see Manchester area - Bolton Institute).

WIRA
(West Park Ring Road, Leeds)

The Research Association system in the United Kingdom was financed in the past out of the levies paid by associate companies, which have now been greatly reduced or abolished; the trend is now towards a service supplier structure with the creation of Business Centres which are run strictly as businesses.

This entails a gradual shift from research activities to

transfers of technology, including publications, analysis and consultancy work, continuing training and the sale of instrumentation developed by the Centre (WIRA takes part in ITMA, the International Textile Machinery Association, exhibitions).

There are three main strands to the research programme which draws on funds from the Textiles and Other Manufacturers Requirements Board (TOMRB) of the Ministry of Industry and Trade:

- textiles (all aspects of wool process technology);
- carpets;
- dry cleaning and product upkeep.

Manchester area

The city and area of Manchester have historically been the home of the British cotton industry which is currently headed by the British Textile Employers' Association.

A variety of establishments are active in this area at various levels of State education and vocational training and research, including:

- Manchester University,
- The Bolton Institute of Higher Education,
- The Textile Institute,
- The Fielden House Productivity Centre,
- The Shirley Institute.

Overall, these establishments have all the elements needed

for definition as a Centre of Excellence; links between these establishments and with employers' and union organizations take place - again not in a very formal way - through a non-statutory training organization (operating as part of the Employers' Association and replacing the previous Public Board abolished in 1981).

British Textile Employers' Association

In addition to the comments above, mention should be made of the Technical and Vocational Education Initiative which is designed to inform young people aged between 14 and 16 on potential jobs in the textile industry (5 hours per week during the last two years of compulsory education).

Universities

UMIST, Manchester University's textiles department, offered full-time three-year courses leading to the following awards in 1985:

- BSc in Textile Process Engineering and Product Management (32 students);
- BSc in Textile Design (31);
- BSc (Hons.) in Textile Economics and Management (72);
- BSc (Hons.) in Textile Technology (34);

In addition there is a comparatively large number of students (some 40 or so) preparing a research-based MSc or PhD.

Bolton Institute of Higher Education
(Deane Road, Bolton)

This Institute of Higher Education is an interesting example of the way in which similar institutes or polytechnics are run in the United Kingdom: it offers a wide range of diplomas (which can be obtained on a full-time or part-time basis - a total of 2 000 students for each method) and also organizes vocational training courses.

It is divided into three faculties (Applied Sciences, Engineering and Training and Arts); the Applied Sciences faculty has a textiles department.

The Textiles Department (specializing in short fibres in particular) has a total staff of 27, two thirds of whom are teachers. Teaching is given on six types of courses (attendance data relating to the 1986/87 academic year):

1. Postgraduate: 3 MPhil (full-time), 2 MSc (full-time), 1 PhD (part-time); research is in most cases sponsored by local industry;
2. Associateship of the Textile Institute (ATI), predominantly academic in nature. Length: 4 years full-time, 7 years part-time (students numbering 88 and 76 respectively);
3. BTech National Certificate in Textiles: of a more practical nature. Length: 1 year full-time, 3 years part-time (students numbering 40 and 167 respectively, including those coming under 4.);

4. BTech Higher National Certificate/Higher National Diploma in Textiles. Length 1-2 years full-time, 2-4 years part-time;
5. Pre-BTech Foundation Course: introductory course on textiles (on request). Length: 1 year part-time, 13 students;
6. Short courses, lasting from a few evenings to a few weeks and aimed at various grades (from machine operators to higher technicians). Over 300 participants.

Various specialized options can be taken on ATI and BTech courses: fibres, spinning, weaving, knitwear, textile finishing, laboratory work.

Fielden House Productivity Centre
(Mersey Road, Didsbury, Manchester)

This private company, set up originally to offer organizational advice to the textile industry, has gradually diversified its range of activities, initially into training (particularly as regards the training of trainers) and then into sectors of industry and commerce not involved with textiles). It has a staff of about 35 people.

Two types of training course are currently offered:
1. Open Learning: this takes the form of fixed-content courses open to anyone interested. They may be organized as short seminars or workshops (lasting from

1 day to 1 week, although there are exceptions especially as regards courses for trainers which can last several weeks) or are organized using the "distance learning" system, including the use of teaching materials designed in a very modern way and advice from tutors and consultants: courses on textiles are offered in Textile Techniques (the equivalent of some 750 "notional hours"), Textile Colouration (330 hours) and General Textiles (487 half-hours).

2. In-house training: demand for this type of training, carried out within firms (generally fairly large in size), is booming. The Fielden Centre has been asked to organize this type of activity by private organizations, government bodies (especially for redevelopment programmes and ESF-funded development programmes) and foreign countries (to help organize and manage vocational training centres during their launch periods).

Despite its very circumscribed sphere of action, Fielden House offers an interesting complement to the activities of the other organizations which provide, in both the area and the sector, the other functions of a Centre of Excellence (higher education, research, transfers of technology). It provides, by its very nature, a very close link with the real needs of industry; its range of activities includes organizational as well as technical advice (an important function in a Centre of Excellence) and as regards training, considerable emphasis is given to

the training of trainers.

Textile Institute
(10 Blackfriars Street, Manchester)

This professional association, founded in 1910, brings together over 10 000 people with high level jobs in the textile industry (entrepreneurs, managers, technicians, researchers, teachers) in some 90 countries.

The association is divided into national sections and organizes periodical conferences and seminars, in addition to its annual convention, which takes place in different countries on themes of major importance and topicality.

The Textile Institute is very active in the sphere of documentation (and consequently in the sphere of technology transfers), publishing its own collections of articles and journals (including the most prestigious scientific textile journal, the "Journal of the Textile Institute") and distributing large numbers of books from a variety of publishers.

Its activities include the award of diplomas to successful examination candidates, including the ATI (Associateship of the Textile Institute) which has academic recognition and for which there are courses in a small number of higher education establishments, for example Bolton.

Shirley Institute
(Didsbury, Manchester)

Founded in 1919 as the British Cotton Industry Research Association, this Institute subsequently diversified into silk and artificial and synthetic fibre research gaining an international reputation. Some 200 people, approximately half from university circles, are active in the Institute. Research is carried out in a wide range of areas, including conventional processes and products (cotton, silk and chemical fibres), nonwovens, filtration, energy, microelectronics, enviromental science, inflammability, microscopy and microbiology.

Analysis and consultancy activities undertaken for industry and the government, as well as internationally, have increased in importance following changes in the structure of the British Research Associations (which could rely in the past on fixed incomes, but now have to be largely self-financing).

In the sphere of technology transfers, the Institute has set up and manages the international databank "World Textile Abstracts", publishing a fortnightly bulletin as well.

Nottinghamshire and Leicestershire area

The British knitwear industry is historically concentrated in this area.

Although the area is comparatively large (which makes contacts slightly more problematic than for example in Manchester and West Yorkshire), there are a number of research and training agencies which overall provide the various functions needed for a Centre of Excellence.

These include:

- Higher Education establishments: Leicester Polytechnic and Trent Polytechnic (in Nottingham);
- other establishments including Hinckley College at Hinckley (which also provides a home for the interesting Knitting Industry Project Update; see below);
- the Knitting and Lace Industries Training Resources Agency (KLITRA) in Nottingham;
- the HATRA Knitwear Research Institute in Nottingham which has an international reputation.

Leicester Polytechnic
(PO Box 143, Leicester)

The Polytechnic has five faculties:

- Art and Design (including the School of Fashion and Textile Design);
- Business;
- Education, Humanities and Social Sciences;
- Science;
- Technology and Construction.

The latter includes the School of Textile and Knitwear

Technology; the Leicester region is is fact the heart of the British knitwear industry.

Various types of training awards are available:

- BSc (Hons.)/BSc in Textile and Knitwear Technology: this course was developed after discussions with local and national industry and is the only degree level course relating specifically to knitwear. It is a sandwich course: 3 years at the Polytechnic and one in industry (year 3);
- Polytechnic Certificate/Diploma in Textile and Knitwear Technology: 2 years which can be reduced to one for students aged over 21 with a minimum of one year's experience in industry;
- BTech Higher National Diploma: 2 years, with 4 possible options (knitwear technology, design, finishing, make-up);
- Textile Technology Associateship of the Leicester School of Textiles (ALST): this award is given to students preparing the BTech Higher level who include a year of practical experience in a sponsoring firm (firms generally put themselves down for students at the beginning of the training period which lasts a total of three years);

Leicester Polytechnic also offers part-time courses (which last proportionally longer) for the BSc, BTech (and BTech Higher) levels as well as:

- a Basic Introductory Course (1 year);
- a four-year course for the award of Associateship of

the Society of Dyers and Colourists (cf. ATI at Bolton).

Research is carried out by students preparing MPhils or PhDs.

N.B. Trent Polytechnic offers a number of MA or BA courses as well as a course for Associateship of the Textile Institute (ATI).

Hinckley College of Further Education
(London Road, Hinckley)

This College provides a home for the Knitting Industries Project Update which is run using the Open Tech system: packages can be put together on a number of topics for payment (UK£ 30 to 175). Firms contact the centre, are visited by a consultant and work out what type of course they want; training is followed up by local managers who do not, however, carry out teaching activities. The programme includes a Trainers Checklist intended for company training managers.

Knitting and Lace Industries Training Resources Agency
(KLITRA) (7 Gregory Boulevard, Nottingham)

This agency coordinates, within the industry's trade association, vocational training for the knitwear industry. Firms are affiliated to the agency and funding of up to 50% of costs can in some cases be obtained from

the Manpower Services Commission. The agency has, among other things, worked on two interesting projects on training requirements and training paths.

It has close contacts with higher education establishments (Leicester and Trent Polytechnics), vocational training agencies (Hinckley College) and research organizations (HATRA in Nottingham).

These establishments carry out technology transfers to differing extents; an extremely important vehicle in this sphere is the internationally recognized journal "Knitting International".

Overall, the Leicestershire area, even though it covers a larger area than that of either Manchester or Leeds, can be considered as a Centre of Excellence since all the main functions are catered for in a fairly coordinated way (despite the lack of formal links).

Training system for the clothing industry

Training for the British clothing industry is coordinated by the Clothing and Allied Products Industry Training Board (CAPITB), whose headquarters are in Pudsey (80 Richardshaw Lane) near Leeds.

The Board employs some 20 people for services to industry and 25 for the Youth Training Scheme (YTS).

It is a national sectoral organization, which operates at local level through regional and area agencies:

- Southern Region: East Anglia, South-East and South-West England and Wales;
- Northern Region: Scotland, North-East England, Yorkshire, Humberside and North-West England.

CAPITB publishes a newsletter (CAPITB-World) and various pamphlets including a list of over 230 training agencies (universities, polytechnics, colleges, sundry organizations) active in Great Britain in the clothing and fashion industry.

Courses on offer include:

- postgraduate courses (at the Hollings Faculty of Manchester Polytechnic and Leeds University, plus other establishments specifically for fashion: Leicester, Manchester and Trent Polytechnics, Winchester School of Art, Royal College of Art in London, Harrow College);
- medium to high level courses in higher education: BA, BSc, BTech High (SCOTVEC in Scotland) and ACFI (Associateship of the Clothing and Footwear Institute);
- lower level courses (college diplomas and certificates, BTech, etc.);

Specializations include:

- Clothing technology and management;
- Engineering and machine technology;
- Courses for supervisors and trainers;

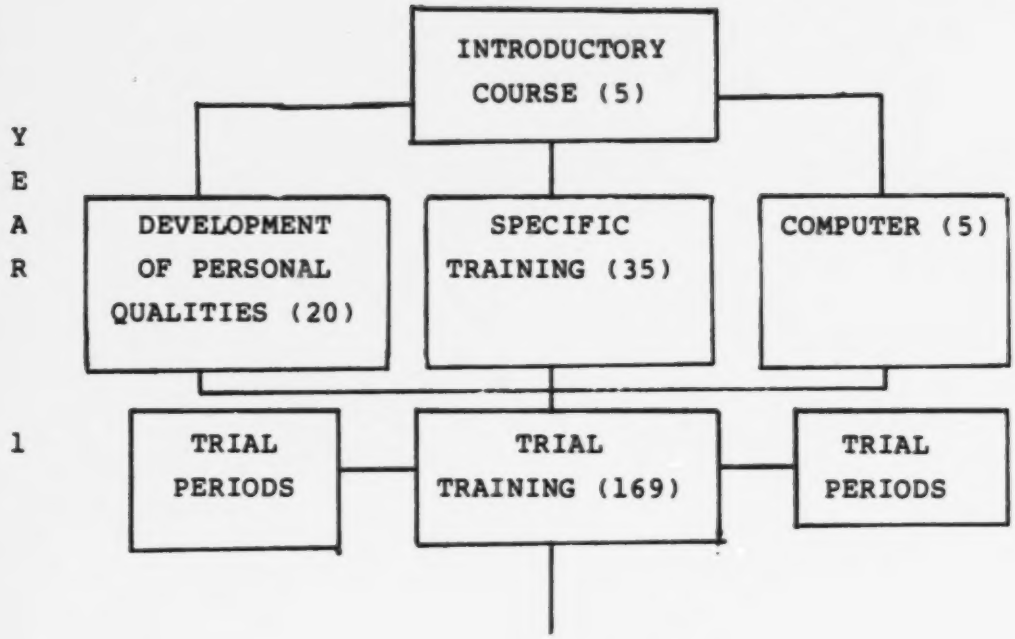
- Fashion.

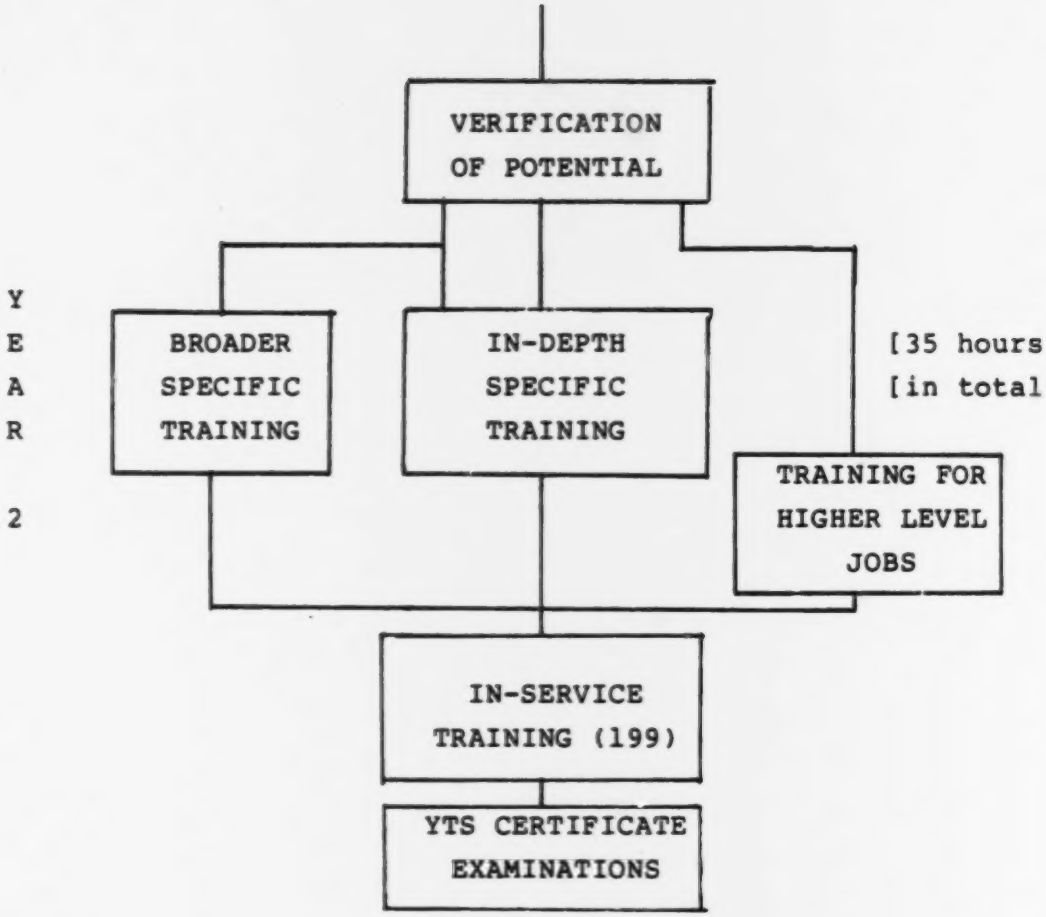
Courses can obviously also be attended part-time, and there are short vocational training courses.

Eight types of service are offered:

1. identification of training needs;
2. development of managerial skills (using a "business-based" approach);
3. vocational training courses for machine operators, trainers, supervisors (regional seminars or in-house schemes);
4. courses for managers;
5. production management;
6. marketing;
7. Youth Training Scheme (YTS);
8. courses on communication techniques.

Firms pay only 0.1% of their wage bills to fund CAPITB (the amount has been greatly reduced due to increases in paid services). A large proportion of the levy is refunded in the form of the grants paid to firms taking part in the YTS (UK£ 20 per week per trainee). There is particular interest in the YTS, which pays a wage directly to the trainee (UK£ 27.30 per week in year 1 and UK£ 35 in year 2); the scheme, which lasts two years, takes the following form (with the respective days of training in brackets):


INTRODUCTORY COURSE (5)
Y
E
A
R
DEVELOPMENT OF PERSONAL QUALITIES (20)
SPECIFIC TRAINING (35)
COMPUTER (5)
1
TRIAL PERIODS
TRIAL TRAINING (169)
TRIAL PERIODS


VERIFICATION OF POTENTIAL
YEAR 2
BROADER SPECIFIC TRAINING
IN-DEPTH SPECIFIC TRAINING
[35 hours
[in total
TRAINING FOR HIGHER LEVEL JOBS
IN-SERVICE TRAINING (199)
YTS CERTIFICATE EXAMINATIONS

Some 5 000 trainees are taking part in the YTS scheme in 500 firms.

College for the Distributive Trades (CDT)
(30 Leicester Square, London)

This Institute coordinates the training of all grades of workers in the distributive trades (from shop assistants to managers) and in many sectors of business.

Various types of courses connected with textiles are offered in the Department of Merchandising:

1. full-time: Textile Distribution Certificate: 1 year (there is also a laboratory for textile testing) Higher National Diploma (HND) at the BTech level with possible specialization in Textile Merchandising: 2 years (the BTech National Diploma in Distribution also includes an option in textiles and fashion with 3 hours of teaching per week);
2. part-time: (daily or in blocks); Licentiateship of the Textile Institute (2 years, evenings); Basic Textile Certificate (1 evening per week over 12 weeks); General Textile Certificate (as above); Textile Analysis and Testing (2 evenings a week for 2 years).

The College for the Distributive Trades also helps, in the areas which it covers, with the vocational guidance programme for students leaving compulsory education aged 16 (Certificate of Pre-vocational Education: 1 year full-time).

3.2.3. Italy

Città degli Studi di Biella
(corso Giuseppe Pella 10, 13051 Biella (VC))

The Città degli Studi project at Biella is intended to bring the various functions characteristic of a Centre of Excellence together in one integrated structure: training (at various levels of State education and vocational training), research and technology transfers.

At present the project specializes in woollen textiles, but - especially at the higher education level - there are plans to diversify into other areas and, in any case, to forge cooperation links with other establishments active in Italy in the industry on issues relating to their own spheres of activity (industrial technical schools, research centres and experimental stations, Tessile di Como, Busto Textile Centre).

The facilities planned (the first two of which have already come into operation at the new site and the third is to be transferred there during 1988) are as follows:

1. Istituto Tecnico Industriale "Quintino Sella" (upper secondary education);
2. Istituto Tecnotex - Città Studi (vocational training and transfers of technology);
3. The "Oreste Rivetti" Institute of the CNR (National Research Council) (research);

4. Specialized college of higher education (university education).

The main feature of these facilities is their physical proximity in the same district: this obviously facilitates their integration, despite the fact that they are run by different bodies (1: Ministry of Education); 2: Public limited company with a majority holding by the Piedmont Region; 3: National Research Council; 4: Polytechnic of Turin), with coordination by the Città degli Studi S.p.A.

It is planned to start work in 1988 on a residence ("College") for teaching staff and students from Italy and abroad on adjacent land: international integration from the point of view of both users and technical teaching staff is one of the express aims of the venture.

Istituto Tecnico Industriale

In the present Italian educational system training for the textile industry (textile specialists, chemists, dyers, knitters, garment makers, designers) is given only at the upper secondary level, with 5 years of studies following compulsory education (school-leaving certificate in technical studies - maturità tecnica); the first two years are introductory in nature and specialist skills are taught only in the final three years. There are a total of 10 schools of this type (Biella, Turin, Novara, Busto Arsizio, Como, Bergamo, Valdagno, Padua, Parto, Naples); Biella has the textile and dye chemistry sections (some 70

or so graduates per year out of a national total of 500).

Under the planned reforms of upper secondary education it seems likely that these sections will to some extent be brought into line; in the meantime, new curricula are being tried out (particularly as regards the new textile and non-textile technologies, for instance computer science), within the "Aracne Project" in which the Biella School is actively participating, having played a part in formulating these curricula.

The school has laboratories equipped with very up-to-date equipment and carries out analysis work for third parties, contributing in this way - and through the work of some its teaching staff - to transfers of technology.

"Quintino Sella" has been selected for the EEC pilot scheme (I - 22b) "Advanced technology" involving close cooperation between schools and industry.

It works together with the Union of Industry in Biella, both within and outside this pilot scheme, on various projects, for example the "Technology Round Table" intended to integrate the training of designers and stylists.

Istituto Tecnotex Biella Città degli Studi S.p.A.

The institutional tasks of this company, whose shareholders include the Piedmont Region, local and

regional industrial associations and other bodies (Province, Commune, Cassa di Risparmio (Savings Bank) of Biella, Unions, Finpiemonte) as well as the Città degli Studi S.p.A., include:

1. vocational training for the unemployed: lower level courses imparting skills to students leaving compulsory education (aged 14) in manual trades (weaving and spinning operatives, for instance) and higher level courses (for example for newly qualified specialists and accountants, for mechanical engineers specializing in textile machinery maintenance, etc.). These courses usually last one year.
2. continuing training for the employed: this is organized for various technical and office grades, with timetables ranging from short courses to early evening courses lasting 100 hours or so;
3. transfers of technology: for this purpose, Tecnotex has a Pilot Plant which is a genuine business providing services for third parties (and is thus largely self-financing) at present including worsted spinning, weaving and dyeing of spun materials. This plant is the central facility of the entire Città Studi project since it provides the wherewithal - under genuine industrial conditions - for practical vocational training, advanced training, practical demonstrations of new technologies and research experimentation; all of which are of benefit, not only to Tecnotex, but to the other agencies active in the Città degli Studi;
4. advanced training schemes: for example "Master"

courses carried out in cooperation with national and international agencies;

5. various support schemes for the textile industry.

Istituto "Rivetti" of the CNR

This Institute, which has been in operation in Biella for some years, will be transferred during 1988 to the new site in the Città Studi district.

Its activities are concerned with the wool industry, on issues such as certification, energy saving, testing of new technologies and enhancing Italian wools.

Through its links with the main databanks in the industry, it is to provide the input for a "window on technology" which will be disseminated to firms jointly with Tecnotex: it is of fundamental importance that questions and answers should not simply be conducted through the medium of paper since there is a need for in-depth action throughout the industrial fabric (consisting of small and medium-sized firms where there are problems of dissemination and testing); the training of technical managers is obviously part of this action, since they must be kept permanently up to date on technological innovations.

Specialized college of higher education

The possibility of organizing lower level university courses (along the lines of engineering courses abroad)

lasting two or three years after upper secondary education has been introduced only recently by Italian legislation.

The Città Studi in Biella is hoping to start organizing courses of this type in the 1988-89 academic year and is to set up - - with the backing and agreement of the Polytechnic of Turin - a college of higher education specializing in textile technology.

Courses will last three years on a full-time basis, including one term of experience in industry. Subjects taught can be divided into three main "strands":

1. general scientific subjects (mathematics, physics, chemistry, plant engineering, etc.) with an engineering "slant" (40% of total timetable);
2. textile subjects (fibres, spinning, weaving, finishing, textile chemistry, etc. - 40% of total);
3. managerial subjects (company management, costing, advanced management techniques - 20% of total).

Courses will be housed for the time being in Tecnotex premises; there are plans to build suitable premises in the future - still in the Città Studi district - which should provide the opportunity to equip laboratories for those specializations (chemical fibres, cotton, etc.) for which there is currently no experimental plant.

3.2.4. Federal Republic of Germany

North Rhine-Westphalia

This Land of the Federal Republic of Germany plays a major role in the textile industry.

It has a number of facilities both for training at various levels and for research and - through the latter - transfers of technology.

The existence of the university (Technische Hochschule of Aachen) completes the system which seems overall to satisfy the criteria for consideration as a Centre of Excellence (Stuttgart is the only other place in Germany in a similar position).

Some further comments on the German education and training system, with particular reference to textiles, are necessary at this point.

After general education (including 4 years at a Grundschule and 5 to 9 years of secondary education, i.e. 5-6 at a Hauptschule, 6 at a Realschule and 9 at a Gymnasium) which is compulsory for 9 years, a range of options are available and it is possible in some cases (although these are rare in practice) to transfer between streams.

The paths most frequently followed in the textile and

clothing sector are:

1. following the Abitur (Gymnasium school-leaving certificate), enrolment at a Technische Hochschule (technological university) leading to the award of the title Dipl.Ing.(TH) after 4 years (8 terms). This award makes it possible to go on to a doctorate (Dr.Ing.) with outlets into research and top-level management;
2. following the Abitur, but more commonly after a Realschule certificate and two years or so of industrial experience, enrolment at a Fachhochschule (college of higher education) which leads to the award of the title Dipl.Ing.(FH) over 3½ years. The normal outlet is into middle to top management in industry.
2. after secondary school (often Hauptschule), enrolment in the dual system for 3 years (2 years for skilled machine operators + 1 year for setters): the weekly ratio between in-house experience (Betrieb) and vocational school (Berufschule) is generally 4:1. After two years experience, it is possible to enrol at a Fachschule (trade school) for 2 years becoming a Techniker (there are other channels for enrolment in a Fachschule, for example 7 years experience, or 2 years in the dual system + 3 years experience).

The institutions visited (see notes below) were:

1. Deutsches Wollforschungsinstitut (DWI - German Wool Research Institute), Veltmanplatz 9, Aachen: research, transfers of technology and doctoral theses (in chemistry or engineering);

2. Institut für Textiltechnik der RWTH (Textile Technology Institute of the Technological University of North Rhine-Westphalia), Eilfschornstrasse 18, Aachen: university technical training (Dipl.Ing.TH) and research;
3. Niederrhein Fachhochschule (Lower Rhineland College of Higher Education), Webschulestrasse 31, Mönchengladbach: higher technical training (Dipl.Ing.FH) and technical assistance;
4. Techniker Fachschule für Textilwesen (Technical School for Textile Technology), Platz der Republik 1, Mönchengladbach: technical training after the dual system.

DWI - Aachen

Optimum links with the university (where the director and vice-director of the institute teach) provide an ideal basis for funding and student availability: in the textile department (the other department deals with insulin) there are 10 researchers (PhD) + 25 students + 20 engineers and technicians + 4 trainees employed as laboratory assistants. 1 researcher thus coordinates the work of approximately two students.

Students work on projects for the required period, projects being decided by the Institute. Demand generally exceeds the number of places available (about 1000 applications per month).

DWI programmes are drawn up by a Scientific Committee including representatives from member industries (30 full members and 80 supporting members, including associations). Each project is monitored by a working group with a chairman from industry; this ensures the transfer. Sources of funds include a smallish direct grant from Gesamttextil (the German textile confederation) (DM 60 000 per annum to DWI and DM 20 000 to the university). The Research Committee of Gesamttextil represents, however, textile interests in the AIF (Industrial Research Association) which has funds of DM 100 million and has a membership of 80 associations, mainly of small and medium-sized industries. Gesamttextil manages to obtain a sizeable proportion of the funds available which it passes on to other agencies including DWI. Gesamttextil is in essence a filter between industrial demand (coordinated by DWI) and AIF funding.

Gesamttextil also funds the transfer, i.e. the cost over and above the DM 120 paid by the contractor for each DWI project (220 for the firm); DWI has to provide Gesamttextil with a quarterly list of projects and their costs. There are some 150 projects in total per year (+ 100 free, and non-financed, services to members). DWI publishes a journal (INFOTEC) for the clothing industry. There is no system of link-people, which would be useful. The Institute's research areas include wool technology (especially as regards chemistry and finishing) and insulin.

RWTH - Aachen

The technical university (Rheinisch-Westfälisch Technische Hochschule, RWTH) of Aachen has 35 000 students (and 10 000 lecturers and permanent staff).

There are 40 students in the textile and textile chemistry streams: the relative institutes belong to the faculties of mechanical engineering and mathematics/natural sciences respectively; the distinction between Dipl.Ing.TH (a minimum of 8 terms, usually 10) and FH is fundamental: students go from the latter into industry and cannot work towards a PhD unless (in practice) they restart the curriculum. University research is funded by firms and allocated both to students and to technicians recruited from the market (with a maximum two-year contract); the main research topics are textile mechanics, with particular reference to new technology (open end, air looms, etc.), making use of the exellent supply of laboratory instrumentation.

Standard courses are divided into 4 + 4 terms, with a preliminary certificate at the halfway stage (which can be used for transfer to other universities): during the first four terms general mechanical engineering subjects are taught to all students in the faculty; specific textile subjects are taught in the second four terms.

RWTH also trains teachers for Fachhochschulen and technical schools. Some analysis work is also undertaken for industry.

Fachhochschule Mönchengladbach

The FH has a total of 9500 students divided between Mönchengladbach and Krefeld; 2000 students are enrolled in the textile and clothing departments (at Mönchengladbach).

Courses (which are less advanced and predominantly "textile" based in comparison with those at the RWTH) last 3½ years and are preceded by at least 6 months practical experience (60% of students extend this practical experience up to 2 years while waiting for admission). They are aged about 25 on completion and 95% go into industry (in contrast to the TH).

In the clothing sector, practical experience can be obtained within the FH since there is a pilot plant (with sales of products). The school has 40 lecturers + 36 company technicians.

Diploma theses are usually carried out jointly with industry on specific topics (general practical experience is obtained before admission, as mentioned above).

Some research projects are financed by industry or the government (supervised by lecturers who also work privately as consultants); the school carries out analysis work for third parties.

At Krefeld there are research institutes for chemistry, textile technology and dry cleaning.

In the continuing training area courses are held on Saturdays for "Meister", i.e. specialists, (6 hours/week over 3½ years with a Chamber of Commerce examination). Seminars (for salesmen, managers, etc.) and training schemes for individual firms can also be organized.

Techniker Fachschule für Textilwesen Mönchengladbach

The textile and clothing division has about 70 students in each stream, all of whom are full-time; in other disciplines (such as mechanical engineering) there is a ratio of 3:1 between students on evening courses (over 4 years) and full-time students (2 years).

At the end of compulsory education, there are normally 2 years of the dual system (for example 4 days in a company and 1 at Berufschule), followed by 2 years of in-company experience; after this training, students can enrol at the Fachschule and are admitted at the age of 22 or thereabouts. After the award of the Techniker diploma, a few students go on to Fachhochschule; the majority, however, find new jobs in industry (which they left with no guarantee of being rehired) in a higher position, for example foreman or assistant foreman.

3.2.5. BELGIUM

Institut Supérieur Industriel de l'Etat

rue de Séroule 8, 4800 Verviers
Tel: 087/223040-221112
Director: Fernand Tiquet

The Institute, which is administered by the main office at Huy, awards university level diplomas of "candidature ingénieur polyvalente" (multi-skilled engineering candidate) (initial 2 years) and "Ingénieur industriel textile" (industrial textile engineer) (4 years in total).

Subjects taught in the first two years (candidature) are divided into 3 groups:

a. scientific training (mathematics, statistics, physics, chemistry, etc.): 49%;
b. technical training (mechanical, electrical engineering, thermodynamics, etc.): 46%;
c. humanities (socio-economics, English): 5%.

In the two specialist years, subjects are split as follows:

a. technical training (computing, automation, etc): 9%;
b. specialist training (spinning, weaving, etc.): 80%;
c. humanities (company financial management, etc.): 11%.

The Institute has also entered into cooperation agreements with both Centexbel and CELAC.

CEFRET (COBOT)

Burggravenlaan 40, 9000 Ghent
Tel: 091-222614
Director General: H. De Leeuw

This is a non-profit-making association called (in French) Centre de Formation, de Recyclage and de Reconversion pour

l'Industrie Textile et de la Bonneterie (Training, Retraining and Redeployment Centre for the Textile and Knitwear Industry); it was set up in 1984 and is governed by a Joint Committee of employers and union representatives. It has a permanent staff of some 20 or so people, supplemented by a network of some 60 part-time consultants.

All courses are free (even "individual" courses); funds come from the National Labour Office (ONEM) and the ITCB. Activities are organized throughout Belgium, although they are centralized in Flanders where most of the Belgian textile industry is concentrated.

CEFRET has a particularly well stocked media library which can be made available to firms and includes, for example, video cassettes on various types of process; it also edits very detailed pamphlets describing the vocational profiles of the various textile trades.

It organizes four main types of activity:

1. Permanent training

This accounts for most of the training offered by CEFRET in accordance with programmes which take account of requirements emerging in the industrial sector. 751 people in employment, on secondment from their firms (19 458 man-hours), were involved in 1986, as well as 139 jobseekers (5547 man-hours) placed by the National

Placement Office. Courses have a modular structure and are put together and rehashed from time to time in line with requirements.

In-company work experience periods are also organized for the unemployed and for teachers.

2. Individual training

The work undertaken in firms by the link-people is fundamental: they gather and define the demand for training and translate it into permanent courses (see above) or into individual schemes (for the most part within firms); CEFRET provides trainers for this purpose.

3. Apprenticeship in industry

CEFRET plays a major role in the part-time teaching system (final 2 years of compulsory education) described above and introduced by the Law of 29 June 1983 (which extended compulsory education to the age of 18). The National Collective Labour Agreement for the Textile and Knitwear Industry, signed on 30 January 1987, introduced training for young people in the textile sector: courses therefore began in the 1987/88 academic year.

Programmes are annual and very diversified (126 in total, although it should be borne in mind that trainees can diversify only if they change host firms).

75% of trainees are subsequently taken on permanently by their host firms, the remainder receiving assistance from CEFRET.

4. Courses for teachers

There is a joint committee with textile teachers. CEFRET helps to keep them up to date with seminars (organized in cooperation with Centexbel in some cases), media library assistance, teacher/firm "symbiosis" schemes, etc.

CELAC

Avenue du Parc 69H, Parc Industriel de Petit Rechain,
Chaineux, Tel: 087/330147
Director: L. Rousseau

This is a Wool and Chemistry Research and Monitoring Centre set up as a non-profit-making association by employers in Verviers in 1953.

It carries out analysis work (textiles and chemistry) in suitably equipped laboratories and provides technical assistance for firms in the form of consultancy, research, certification, technical and commercial information, conferences, etc. The advanced courses for textile graduates or engineers have already been mentioned.

CENTEXBEL

Head Office: 24 rue Montoyer, 1040 Brussels
Tel: 02/2309330

Verviers Laboratory: Zoning de Petit Rechain,
Avenue du Parc 69H, 4655 Chaineux
Ghent Laboratory: Sint Pietersniewstraat 41,
9000 Ghent
Officers: J. Stryckmann - Director General
J. Grignet - Verviers Division
J. Knott - Verviers Division (chemistry)
M. Van Lancker - Ghent Division

There are fifteen or so researchers at Verviers and about twenty at Ghent, plus 10 link-people and students preparing their theses. A particularly interesting aspect of Centexbel's activities, predominantly research, documentation, analysis (at Ghent) and some training seminars (see above), is the system of technical assistance for firms carried out through two types of operator commuting between firms and the central laboratories:

1. "technological guidance" officers whose aim is to assist firms, especially small and medium-sized firms, providing them with information on scientific and industrial advances which can be directly applied and helping them to find ways of increasing productivity and to implement product and process innovations. The needs of industry can be pinpointed and better defined in this way: these may take the form of simple bibliographical enquiries, laboratory tests and research and even genuine small-scale research projects;

2. "liaison" officers whose task is more specifically to help firms to transpose Centexbel's research findings into their own industrial situations and to promote research activities in textile firms.

In both cases, a feature which is typical of the Belgian support system for the textile sector (discussed above in respect of training at CEFRET) seems to be emerging, i.e. timely "on the spot" monitoring of the actual needs of industry and transfers of findings which are very effective because of their comprehensive nature.

It is clear that a model of this type is fully in keeping with the "philosophy" of the functions of a sectoral and regional Centre of Excellence (Belgium can be seen as a whole as a region, bearing in mind geographical distances).

As pointed out above, Belgium can be seen as an area for a single Centre of Excellence with the result that all the structures described above have to be considered together and all, with no exceptions, converge on this objective. They provide, each in its own field, all the functions which have been pinpointed in the general report as the features of a Centre of Excellence: research, technology transfers, school education and vocational training, in an overall system covering the textile industry as a whole. The degree of integration between the various

establishments, which can and has been verified even in terms of the personal relationships between the respective officers, seems satisfactory: the most relevant point of connection, if it is necessary to provide a more formal link, is in all likelihood Centexbel which is active throughout the country and maintains operational links with the university education system and with CEFRET: this latter organization can act as an intermediary for secondary education in the textile sphere, while the role of other vocational training institutes, not examined in this report, has still to be worked out, but is probably of little importance in the light of the 1987 agreement and the previous creation of CEFRET as a State-recognized joint body where both sides of industry are represented.

3.2.6. Initiatives at EEC level

A wide range of research and development, technology transfer and training assistance programmes have been launched and funded by the Commission of the European

Economic Communities: it is precisely these three fields of action which have been highlighted as the criteria for a Centre of Excellence in the textile industry.

Among the various programmes (listed and described in a Comitextil (Coordination Committee for Textile Industries in the EEC) document entitled "Inventory of European Community Research Programmes), the following are of special importance for the purposes of this report:

A. Research and development

1. BRITE (Basic research on industrial technologies for Europe): in its present form (BRITE 1), the programme has little to offer the textile industry, with the exception of the clothing industry (flexible materials technology): Comitextil's Research Committee is thus endeavouring to make it easier for topics of interest to the textile industry to be included in the future BRITE 2. It should be noted, however, that some of the agencies discussed in this report (the ITF, for instance) have played an important role in promoting and coordinating the (few) projects submitted and accepted, bringing together both national and international industrial partners as required by the rules of BRITE.
2. ENERGY demonstration projects: two projects have been submitted to the European Commission through Comitextil.
3. Programmes relating to the protection of the

ENVIRONMENT: the agencies represented on Comitextil's Research Committee have agreed on and drawn up a long list of topics involving the textile industry.

4. APPLIED METROLOGY: this topic is being studied by Centexbel and Denkendorf.

B. Transfers of technology

1. Action 29: MODERNIZATION OF TRADITIONAL INDUSTRIES: action in this area was carried out in 1986/87 together with the ENEA (Italian agency for alternative fuel sources) secretariat in the textile industry (as well as in the footwear and ceramics industries). This made it possible to strengthen the ties already existing between agencies active in the field of research and development and transfers of technology in the various Member States and to lay the foundations for future, more formal coordination. The action (in which ITF, the Shirley Institute, DWI and Città Studi, among others, took part) has led in particular to an awareness of the need to update information on the position of supply and demand in some priority areas (CAD, new materials, sensors, cutting technologies) and the organization of 4 seminars held by experts from the various Member States with large-scale industrial participation:
   - CAD applications in the textile industry (Barcelona, 28.3.87);
   - fixation and migration of colouring agents during high frequency treatment (Ghent, 7.5.87);

- use of sensors in some stages of textile production (Veenendaal, 23.9.87);
- quality control (Biella, 29.10.87).

2. Action under the SPRINT programme: some of the agencies discussed in this report (ITF, DWI, Rivetti) have submitted, together with other agencies, a proposal for transnational cooperation between industrial research institutes, technical institutes and similar organizations (2B): the aim is to set up a technology transfer network for European textile firms based on in-depth information on industrial demand and the know-how of individual institutes. There are also plans to submit a connected application for the promotion of European seminars on topics relating to research and innovation (2C) with particular reference to the ITMA Textile Machinery Exhibition held in Paris in October 1987.

C. Training

1. COMETT: this programme is intended to promote cooperation between universities and industry on issues connected with technology. A particularly important objective - in the context of the creation of a European network of Centres of Excellence - is to promote the joint development of training programmes and exchanges of experience and to respond to the changes taking place in technology.

Particular proposals include the creation of a European network of associations between universities and industry, the promotion of teacher and student exchanges and the inclusion of continuing training in the scheme.

A network of Centres of Excellence would obviously be the ideal way, in the textile industry at least, of bringing these ventures to a satisfactory conclusion.

2. ERASMUS: this programme is intended to promote exchanges of students and to increase cooperation between universities in the EEC - and includes measures to assist student mobility and provide mutual recognition of study awards. A specific part of this programme is to set up a European university network in which Centres of Excellence should be able to take part.

4. CONCLUSIONS

Analysis of the various case studies included in the sample of potential Centres of Excellence has made it possible to formulate the structural criteria (assessed only from documentation when the sample was being selected) in an improved way and to examine the operating criteria, which were not assessed from the documentation, in detail.

The structural criteria for a Centre of Excellence can be defined as follows:

- geographical comparability, i.e. a socio-economic sub-area with significant numbers of textile-producing firms, or sectoral comparability in a specific product area (knitwear, weaving) irrespective of the geographical location of production units;
- existence of basic education facilities (State education) at the upper and lower secondary school level and at the university and higher education level;
- existence of vocational training facilities for young school leavers trying to find their first jobs (after upper and lower secondary school) and for continuing training;
- existence of facilities for research and technological dissemination, operating both as a supplement to teaching in basic education and vocational training and as independent providers of services for production units working in the sub-area and/or in the sector.

To assess operating criteria, it is necessary to monitor the existence of particular conditions of overall contact between the various agencies involved and the existence of synergetic interactions based on specific objectives (formally in some cases, informally in others).

These types of synergy must, however, be based on organic methods and procedures, which may well be informal, but are not random and can thus be reproduced and defined from the point of view of objectives, resources used and methods.

Operating criteria can be summarized briefly as follows:

- reciprocal contacts between the various agencies located in the area in question to disseminate information on issues relating both to basic education and vocational training and to research and the dissemination of technology;
- interactions between vocational training and basic education;
- interactions between vocational training and basic education and the firms working in the reference area and/or sector;
- interactions between training facilities and research and technological dissemination.

These interactions as a whole pave the way towards synergy between the various agencies involved in the reference area or sector and in this way provide the foundations for the creation of a Centre of Excellence as a unitary and

organic structure able to provide specific "services" (training and technological research and dissemination) in an integrated way.

This condition could enable a number of Centres of Excellence in the various EEC Member States, along the lines of those included in the sample, to work closely together on common projects, overcoming structural and legislative differences in the various national contexts in the areas of training and research and technological dissemination taken as separate issues.

The various Centres of Excellence could in this way be compared in terms of the objectives to be achieved, which are more or less comparable since they relate to a specific production system, such as the textile industry, which is also fairly comparable in terms of its product and process technologies despite differences in the ways in which industry is organized in different countries.

This condition provides concrete potential for the development of supra-national joint projects relating to the Centre of Excellence as a whole and not to the different agencies on which it is based, which, in contrast, embody all the differences and special features of training and research and technological dissemination in EEC Member States.

Using the Centre of Excellence model would in substance have the effect of integrating the far-reaching

differences between Member States, before they have any impact on joint work, at levels higher than those of the individual facilities operating within the Centres of Excellence themselves. Since integration would take place at the level of a production apparatus such as the textile industry, which is fairly comparable in all the different countries, it would be possible to use a potential future European network of Centres of Excellence as the main framework of reference for development and cooperation initiatives in the areas of training and research and technological dissemination which the EEC could undertake (and has to some extent already undertaken, although without adequate attention to potential synergy between the various functions).

All the Centre of Excellence case studies analysed satisfy the structural and operating criteria discussed above.

There is, in general, genuine synergy and integration between the various facilities forming the Centres, although this is often managed informally.

The different ways in which education and training and research and technological dissemination are organized in the five Member States analysed are important in this respect.

In some cases, for instance France and West Germany, the close links between and complementary nature of basic education and vocational training provide an objective

basis for developing synergy between these two aspects of training at the Centre of Excellence level. The unambiguous and minutely detailed way in which occupational skills are defined facilitates synergy between the training system and production structures (as is again true of France and West Germany).

On the other hand, the open and almost "self-managed" structure of the British training system could allow, in the various Centre of Excellence situations, high levels of synergy between, on the one hand, the permanent or continuing vocational training system and the production system and, on the other hand, basic education.

Finally, the almost pathological vagueness of many of the elements of the Italian training system allows scope for interesting institutional creativity, making it possible to try out forms, often new, of mixed public and private management of training and of research and technological dissemination, facilitating the establishment of formal integration links between the facilities making up potential Centres of Excellence.

The contributions made by the different countries, exemplified here by a few typical situations, could make it possible to move from a situation of potential and informal Centres of Excellence to a concrete situation which can be formally implemented.

This passage depends, however, on a number of factors:

- the will of the facilities involved (although, to our satisfaction, a great deal of interest has been evinced in the case studies analysed as regards this factor and the possible concrete advantages that greater supra-national integration could provide, not just for the EEC, have been viewed extremely favourably; (in some cases, for instance research into wool, informal cooperation has been taking place for some time);
- the legal and institutional framework of the various Member States;
- practical and convinced support from public institutions, in particular from employers' and union organizations in the Member States involved;

From the point of view of functions, a Centre of Excellence which has been formally identified and established should operate at a number of levels as regards the social system:

- at the vocational training level with an organic system which enables:
  a. closer links between basic education and the demand for skills coming from the labour market;
  b. the launch of a flexible system of permanent and continuing vocational training with a modular structure and a high level of flexibility as regards possible personalized curricula, in the design of which a specific guidance structure could play a part;
  c. the development of technological and organizational "design" work enabling a more timely updating and

revision of work organization models and the occupations to which they relate;

- at the level of technological research and dissemination, by expanding dissemination activities within the fabric of industry and updating teaching contents within training facilities;
- at the level of research and technological dissemination, by coordinating, in close cooperation with national research facilities, specific research and technological dissemination schemes covering problems which are of particular interest to the reference area or sector of individual Centres of Excellence.

From the point of view of working methods, the criteria for defining a Centre of Excellence as an integrated structure of the type described in this report are chiefly:

- the existence of genuinely operative functions (even if they are not structurally specialized) which ensure links and an interface with other Centres of Excellence and with the EEC and which ensure the implementation of projects based on the work of the Centres;
- the existence of executive design functions which make it possible to work out the specific details of supra-national project proposals and proposals of national interest;
- the existence of operative planning functions able to put joint projects into practice.

From the institutional point of view, Centres of Excellence could be run in a variety of ways depending on national circumstances; it is necessary in all cases, however, to coordinate the functions and assess the technical and scientific viability of the schemes and activities carried out.

Structures of this type are already in existence in the five Member States examined in this report, whether at national level (for instance the German AIF or French ITF systems) or specific to small areas (for instance the many examples of geographical and sectoral consortia or public companies in Italy).

If we are to proceed beyond the initial stage of feasibility examined in this report, to a stage at which a potential international Centre of Excellence model can be designed and experimentally launched, a specific study must be undertaken to evaluate the concrete potential for promoting integration from the outset between the individual functions (in a specific area and/or sector) taking those EEC training and research schemes reviewed briefly in Section 3.2.5. as a basis.

This will facilitate subsequent integration at the overall Centre of Excellence level.

The inherent features of the textile industry could make it a very good field in which to work, taking a number "case studies" as a test bench for the theories outlined

in this report.

Among the problems emerging from our analysis of the national case studies (for the solution of which, moreover, the existence of a network of Centres of Excellence could provide a very effective means of study and action), the following, at least, should be noted:

a. the differing stress placed on in-house experience in vocational training curricula and - in some cases - in school curricula (the borderline case being that of the Federal Republic of Germany);

b. in connection with the above point (which may entail substantial differences in trainee ages at the end of training schemes with similar objectives), the problem of defining whether study awards are equivalent;

c. the variety of agencies to which medium to high level continuing training is delegated in the various Member States (the exception being France in which the ITF has a predominant role).

ANNEX

TECHNOLOGY TRANSFER IN THE UNITED STATES

1. PRESENTATION

In 1962 NASA, the American space agency, launched a programme designed to accelerate and extend the transfer of space research spinoff technologies to other sectors of the economy.

The main resources deployed are:

- a series of publications describing the new technologies developed under NASA programmes;
- ten regional offices for the dissemination of information;
- a number of industrial applications centres (Indianapolis, Pittsburg, Storrs, Research Triangle Park, Albuquerque, Los Angeles) through which potential users can gain access to information and technical, scientific and managerial know-how;
- a computer software information and management centre (programmes for industry and Government agencies).

The NASA Centers - even making allowance for the diversity of national situations - are an interesting example of how real services can be made available to the industrial system.

Particulars of innovations that are spinoffs from special programmes are entered in specialist databases that can be accessed by companies via centres throughout the country (most of them at universities). These centres can point a company seeking information in the right direction and above all they can offer support in the use of technology.

2. OBSERVATIONS

0.0 Introduction

In the American economic system, there are no variables - cultural or scientific - that cannot be promoted on a financial basis. It is easier than elsewhere, then, to examine the process of technology transfer in the U.S. in terms of:

1.0 product: what is being transferred

2.0 current and future market: where the technology is being transferred

3.0 promotion and sales media and resources: how to transfer the technology

1.0 Product: what is being transferred

In essence the technology available is information. As far as the product is concerned, then, "technology transfer" and "information transfer" are synonymous.

The information is contained in a series of electronic memories called databases.

The NASA centers do not create their own databases, but are users only.

Users sign agreements with the database owners entitling them to access the information against payment.

The aim of NASA technology transfer centers is not to create technology, just to make its industrial and commercial use possible.

1.1 Databases

The product being sold, then, is the information contained in the databases.

The owners and/or creators of the databases used are:

a. - Central Administration, more specifically the Department of Energy and the Department of Commerce

b. - Professional associations (for example, graduates in chemistry or textiles technology, professional promotion groups)

Recently firms set up for the specific purpose of creating databases have made their appearance.

c. - Public Research Centers (structured and funded along more or less the same lines as the National Research Council in Italy)

d. - Private universities

e. - NASA

The centers use and provide not only the information derived from NASA studies or research but also **any information existing on the market in database form.**

The information contained in the databases is on established technologies but, through their contact with the universities, Research Centers and NASA, experts are able to find out about technologies in the research stage as well.

1.2 What information is contained in the databases?

The Centers can reply to enquiries about processes, products and marketing. Typical enquiries are:

a. - Have any patents been filed in the US on a particular subject?

b. - How is a product or material used in a given technological process?

c. - What are the other potential uses of a product?

d. - What is the potential market for a given product?

As will be noted, the information is not just on scientific or technological subjects in the narrow sense; it also extends to potential applications, market, profitability, etc.

1.3 The Centers state that they offer five types of service:

a. - Information (databases)

b. - Engineering studies: research applied to specific problems (especially materials)

c. - Technical and scientific publications

d. - The identification of emerging technologies

e. - Database management planning

1.4 The financial basis for database provision is as follows:

a. - Private or public bodies create and update databases;

b. - They offer them for sale to anyone wishing to buy, including the Central Administration;

c. - Databases survive only if they are useful enough to acquire a remunerative market;

d. - There are bodies whose business it is to group and sell links with several databases (Dialog, for example);

e. - Any company can purchase the right to put queries to the databases, except in the case of information that is a military secret.

We shall see why companies normally prefer to go to the Centers rather than reach direct agreements with database owners.

The market, then, is essentially the judge of whether databases are viable, creating the incentive for their improvement and updating.

The structure of the revenue derived by the technology transfer centers, which are non-profitmaking, is as follows:

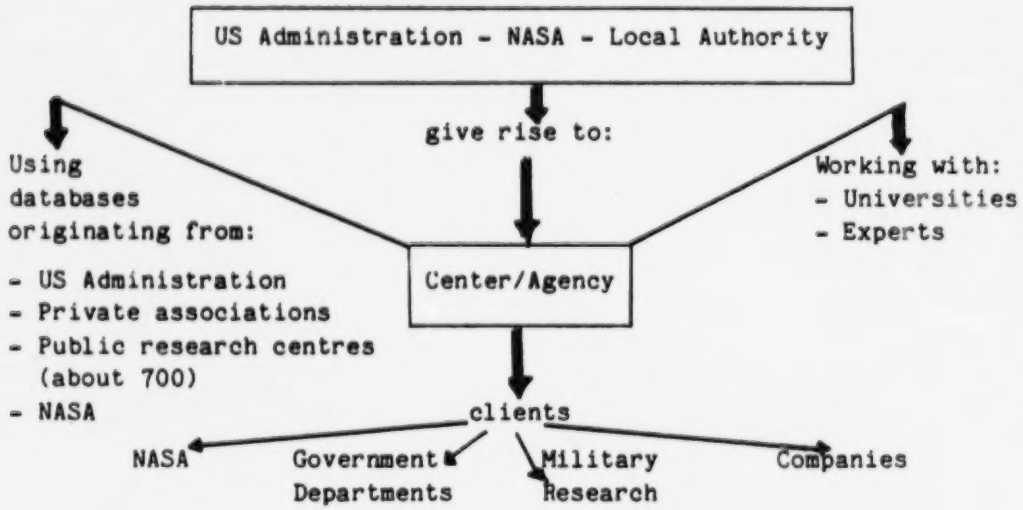
90% from invoiced turnover

5% from NASA for serving as a link for specific programmes

5% from Central Administration

Profits are reinvested. Any losses are met by Central Administration, although it then has the right to close down the center.

1.5 The way Centers operate can be shown in diagrammatic form:



1.6 For the creation and use of databases, there must first be professionals such as:

- experts in information-gathering and computer storage
- experts in software for database integration programs

2.0 The market: who buys the information stored in the databases?

The agencies are not widely used in the United States. NERAC in Storrs, Connecticut, says that it receives 2,500 queries a month; NIAC in Pittsburg has 200 subscriber companies, although they include some of the largest companies in the world.

Recourse to these two agencies by companies is the result of specific efforts that have continued for more than 15 years (NERAC).

"On-line technological information" is not an easy product to sell. It calls for companies that are prepared to pay to obtain help and that are therefore research-minded.

Unless companies are first clear in their minds about the questions they are asking, it is hard - and often serves little purpose - to give any replies.

The approach taken to the problem of how to activate demand will be discussed in section 3.0.

2.1 The market consists of Government agencies, universities and companies.

2.2 Companies use the services offered for various reasons:

a. - for diversification
b. - to obtain further information on specific innovations in the processes or products they use
c. - to solve unforeseen problems
d. - to inform themselves on markets

2.3 The companies making the most use of the service are in the following sectors (excluding calls on the service from Central Administration and the military authorities):

- computers
- information technology
- space
- pharmaceuticals
- the use of new materials

Few enquiries are received from textile firms. The agencies tend to serve companies in their own geographical area and this list may vary, but the textile industry consistently comes low on the list.

2.4 The companies that use this type of service tend to have a workforce of over 200. The main supporters of the programme are large companies, even though - for example - the Connecticut authorities oblige NERAC by law to charge concessionary rates to smaller companies.

2.5 Companies specializing in high-technology manufacturing or services tend not to use this type of service but to be direct partners or colleagues of the universities or the agencies.

It seems that companies regarding themselves as super-specialists in their own field adopt a similar attitude, even though they do not use particularly sophisticated technologies.

The Pittsburg Chamber (roughly comparable to our Chamber of Commerce) has conducted a survey of the local companies to find out how useful the information handled by agencies can be in an area faced with serious economic and employment problems, like Pittsburg, whose economy is based on steel production. The responses it obtained were positive on the whole.

2.6 Everyone regards technology transfer as one of the most significant factors in the new post-industrial era, and considerable growth in this type of activity is predicted.

3.0 The media and resources for the promotion and sale of technology transfer

As already mentioned, the companies making up the potential market for "computerized technological information" were not prepared or predisposed to make contact with the transfer Centers.

When NASA was starting up in the 1960s it tried to make contact with companies in two ways:

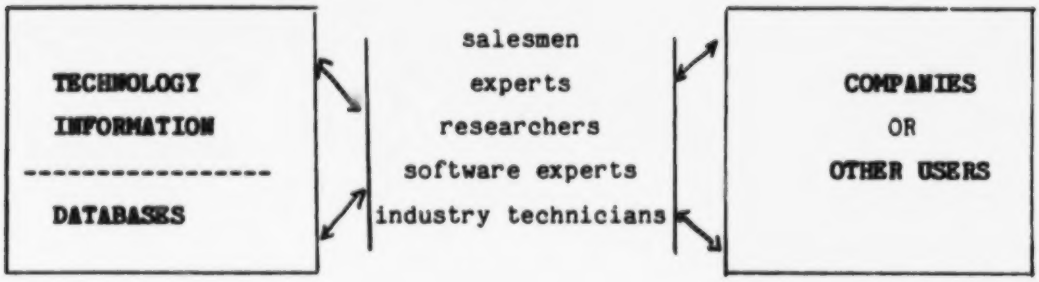
1. first through lectures, inviting industrialists to come and find out about the potential for the application of technological information. This approach did not work.
2. then through "industrial application centers" which companies had to visit for themselves. This approach did not work.

Not until the 1970s was a new approach adopted: what might be called "bringing the experts out of their offices and onto the shopfloor".

The problem is not a new one in American society. Universities, especially private universities, have to sell their product, "education", on the market, and the quality of that product must be such that it can be purchased at an economically viable price. Because of this, a professor who has achieved a reputation in his own particular scientific field (in the Nobel Prize race) has to contend with the need for his research to have a practical outcome, one that can be used by the companies who create this reputation, so that there is an inflow of commissions for further research. Thus **education and research combine in an economic "virtuous circle".**

This problem is illustrated by the experience of the Robotic Centre in Carnegie and Mellon University (a private university in Pittsburg), 70% of whose revenue is derived from industry and 30% from Department of Defense orders. The 70% of funding from the open market is for research whose findings can be put to industrial and economic use.

3.1 Technology transfer flow diagram



3.2 The need for an intermediary between the Product and the Market is created by two factors:

1. The product (information) is available in a format in which it cannot be directly used by companies. This is because of the enormous volume of information and the difficulties companies often encounter in identifying and defining their problem in such a way as to make a database search useful, and so that the information can then be translated into terms of the company's actual situation.
2. Companies have to be encouraged to become clients: the level of spontaneous demand is very low.
   In other words, someone has to create the market.

3.3 The image and credibility of this intermediate factor in technology transfer are of vital importance.

3.4 The "technological information transfer" salesman, a professional quite unknown to us in Europe, is fairly common in the US, in view of the system of funding university research and education there. His job is to contact companies, tell them about the product and stimulate demand.

1. **Research technicians**

These are the key factors in the transfer process. They:

- interrogate the databases
- interpret the information they obtain in the light of the client's queries
- conduct further research on the information they find
- maintain contact with universities and research centers
- draw up research plans where necessary
- act as an intermediary between the clients and the experts in a particular sector or technology
- when required, agree on programs with the software designers

2. **Sector technicians**

These are experts in a specfic technology. In many cases they are not employed directly by the transfer center but work in companies or the universities or are self-employed, being called in as outside consultants.

3.5 NERAC personnel are employed by the State of Connecticut and NIAC personnel by the State of Pennsylvania (under the same kind of arrangements as are applicable to State universities). Nevertheless, their salaries are reimbursed by the two agencies.

In tne United States, unlike Italy, switching from the public to the private sector and to the university world is very easy and flexible, especially as

- pay structures are comparable;
- the selection system is similar;
- the career prospects are good.

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2. **LYCEE PROFESSIONEL DES LOMBARDS**

   10 - 16 avenue des Lombards
   10000 Troyes
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3. **CENTRE DE LA BONNETERIE DE TROYES**

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3. **KLITRA**

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Exploratory study of the role and activities of 'Centres of excellence' in the textile industry in four EEC Member States

Texilia, Istituto per la tradizione e la tecnologia tessile SpA

CEDEFOP Document

Luxembourg: Office for Official Publications of the European Communities

1988 — III, 147 pp. — 21.0 × 29.7 cm

EN, IT

ISBN 92-825-8936-6

Catalogue number: HX-53-88-366-EN-C

Price (excluding VAT) in Luxembourg: ECU 5

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Price (excluding VAT) in Luxembourg: **ECU 5**

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ISBN 92-825-8936-6

9 789282 589366